BS 8542:2011

BSI Standards Publication

Calculating domestic water consumption in non-domestic buildings – Code of practice

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ISBN 978 0 580 71075 9

ICS 13.060.20

The following BSI references relate to the work on this standard:
Committee reference B/504
Draft for comment 11/30218883 DC

Publication history

First published October 2011

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 38, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 October 2011. It was prepared by Panel B/504/2/2, *Water consumption in buildings*, under the authority of Technical Committee B/504, *Water supply*. A list of organizations represented on this committee can be obtained on request to its secretary.

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.

In particular, attention is drawn to the following regulations which may be amended from time to time. The commentary in this British Standard reflects the state of the regulations in 2011.

In this document, the following national regulations, which apply to plumbing systems in premises to which a supply of public mains water has been provided, are referred to as the "Water Fittings Regulations" [1]:

- The Water Supply (Water Fittings) Regulations 1999, in England & Wales;
- The Water Byelaws 2004 (Scotland), in Scotland;
- The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009, in Northern Ireland.

0 Introduction

0.1 General

Calculating water use in non-domestic buildings provides a means for estimating a building's impact on water consumption whether looking at the consumption of new or existing buildings. Calculating water use in non-domestic buildings also provides a means for estimating the impact of a terminal fitting on an individual basis to inform procurement choices. Figure 1 provides a guide on the calculation procedure.

There are common water uses between different building types, e.g. the use of wash basin taps in a restaurant is similar to that found in an office or a hotel, but variations also exist, e.g. water use for showering.

NOTE The domestic water use requirements for an employee may be simplified into key water uses including water used for WC flushing and other sanitary purposes, water used for drinking, and water used in food/drink preparation and washing-up.

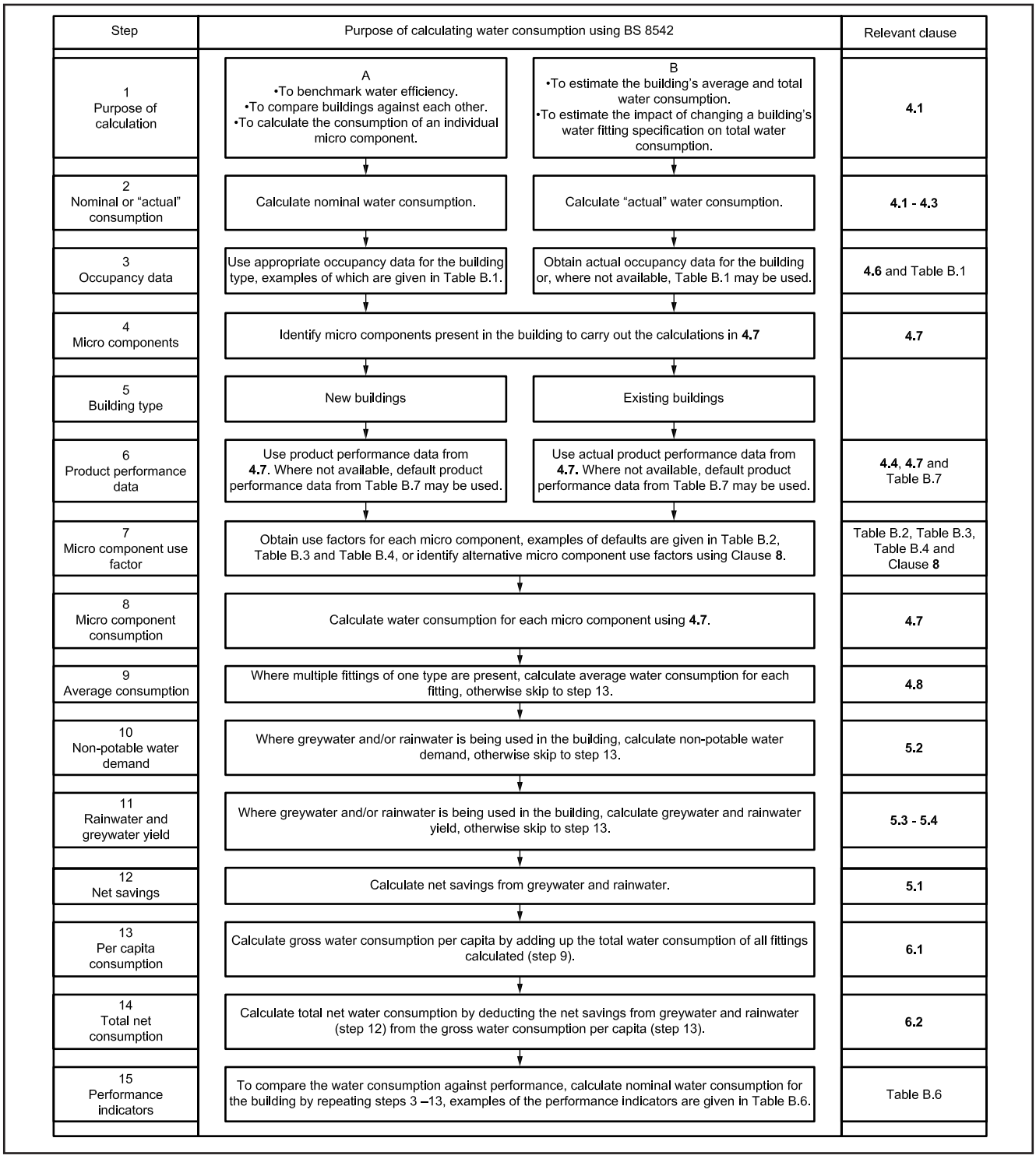
With an increasing demand for water efficiency in non-domestic buildings, a standardized framework for reporting water consumption is useful to allow designers, specifiers, building managers, water authorities and product manufacturers to estimate and report water consumption in a consistent way.

0.2 Non-domestic building types

There is a wide range of building types that constitute non-household buildings including, but not limited to:

- offices;
- restaurants;
- retail buildings;
- industrial buildings;
- hotels;
- leisure buildings;
- education buildings.

Figure 1 **Calculating water consumption using BS 8542**



1 Scope

This British Standard gives recommendations for calculating the volume of public mains water that is consumed per head per day, per unit per day, or per building per annum for domestic use in non-domestic buildings. It gives recommendations for estimating the total water use from the buildings' components, allowing consumption to be indicated on a whole building level against other buildings for best practice levels.

This standard is not for use as a design guide.

It provides a framework for and details the development of water use calculation methodologies in non-domestic buildings. It provides recommendations for the quality of data used to calculate water use for each component in non-domestic buildings and also standardized reporting for product performance data.

It applies to both new and existing buildings and covers:

- water that is sourced from unwholesome sources such as rainwater harvesting systems or greywater reuse systems; and
- water that is sourced from wholesome sources including both hot and cold water.

This British Standard does not cover design, installation, testing and maintenance of services supplying water for domestic use. Water use in industrial processes or for agricultural, medical or fire suppression applications and external water use such as irrigation or building services, e.g. air conditioning plant and cooling, are also not covered.

It does not provide all data for calculating water use in non-domestic buildings, but provides recommendations for the data used to calculate water use in non-domestic buildings. This includes the product performance data for each terminal fitting and water use research data determining the frequency and duration of use for each terminal fitting.

NOTE Total water use may be determined by metering the building, although it might be difficult to differentiate between domestic water uses and water use for other purposes unless these are sub-metered.

2 Normative references

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

BS 8515:2009, *Rainwater harvesting systems – Code of practice*

BS 8525-1, *Greywater systems – Part 1: Code of practice*

BS EN 200, *Sanitary tapware – Single taps and combination taps for water supply systems of type 1 and type 2 – General technical specification*

BS EN 817, *Sanitary tapware – Mechanical mixing valves (PN 10) – General technical specifications*

BS EN 997, *WC pans and WC suites with integral trap*

BS EN 1111, *Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification*

BS EN 1286, *Sanitary tapware – Low pressure mechanical mixing valves – General technical specification*

BS EN 1287, *Sanitary tapware – Low pressure thermostatic mixing valves – General technical specifications*

BS EN 13407, *Wall-hung urinals – Functional requirements and test methods*

BS EN 14055, *WC and urinal flushing cisterns*

BS EN 14743+A1, *Water conditioning equipment inside buildings – Softeners – Requirements for performance, safety and testing*

BS EN 50242 (BS EN 60436), *Electric dishwashers for household use – Methods for measuring the performance*

BS EN 60456, *Clothes washing machines for household use – Methods for measuring the performance*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 building terminal fittings
different components of water demand

NOTE This includes devices such as WCs, showers, baths, washing machines, dishwashers and taps.

3.2 cistern
fixed, vented container for holding water at atmospheric pressure

3.3 collection area
plan area of the roof or other collection surface, which is to be drained to the rainwater harvesting system

3.4 covers per m^2
number of dining spaces per m^2

3.5 domestic water use
use related to residential or similar dwellings

NOTE 1 Domestic potable water use includes water for the kitchen sink, wash basins, bath, shower and dishwasher. Domestic non-potable water use includes water for WC flushing, domestic washing machines and garden watering.

NOTE 2 In commercial, industrial or public premises, "domestic use" is limited to water used for those applications/appliances described above and excludes, for example, water used for fire fighting, central heating or irrigation systems.

3.6 effective flushing volume
average volume of water discharged from the flushing device during a flush cycle

3.7 flushing device
device fitted to a cistern to provide controlled, measured volume(s) of water to a WC suite or urinal for flushing

3.8 flush-free
WC suite or urinal designed to operate without the use of a flushing device

3.9 frequency of use factor
average number of uses per day of a terminal fitting based on nominal usage

3.10 greywater
domestic wastewater excluding faecal matter and urine

NOTE This British Standard covers systems using washroom and bathroom greywater including greywater sourced from wash basins, showers and baths.

3.11 hydraulic filter efficiency
loss of rainfall volume collected as a result of the filtering process

3.12 intensity of use factor
average water use of a terminal fitting for each user event as a result of the duration of use and/or the proportion of a terminal fitting's total capacity used per event

3.13 regeneration process
part of softener operating cycle, during which all the operations needed to restore the ion exchange capacity of a resin bed are carried out

3.14 regeneration water
quantity of water, expressed in litres (or in cubic meters), necessary for a complete regeneration process, including water used for the preparation of the brine

3.15 non-domestic building
building other than a dwelling

NOTE A dwelling is a self-contained unit designed to accommodate a single household.

3.16 non-potable/unwholesome water
water not suitable for human consumption that does not meet minimum legal requirements for wholesome water

3.17 per capita consumption
water use in units of litres per person per day

3.18 potable/wholesome water
water suitable for human consumption that meets minimum legal requirements for wholesome water from mains or private extraction

3.19 rainwater
water arising from atmospheric precipitation

3.20 softener
complete installation necessary for the ongoing production of softened water

3.21 softening
reduction of the hardness of water by exchange of alkaline earths ions (mainly calcium and magnesium) with sodium ions, by passing through a bed of cation exchange resin in the sodium form

3.22 terminal fitting
water outlet device

3.23 yield co-efficient
factor that represents the loss of rainfall volume from wetting of the collection area as a result of pitch and surface type

4 Water consumption calculation methodology

4.1 General

The total domestic water consumption in a non-domestic building should be calculated using the following four parameters:

a) the performance of all terminal fittings as described in **4.7**, e.g. the flow rate of a shower (L/min);

b) the frequency and intensity of use of the terminal fitting, e.g. the number of showers taken per day and the duration of each shower (min);

c) occupancy data, including the total occupancy, operating hours and male to female ratio; and

d) the volume of unwholesome water available, including the yield and demand for greywater and rainwater supply systems (L).

Water consumption should be calculated using either of the following two approaches:

1) calculated actual water consumption for the building; or

2) nominal water consumption.

The required use of the calculation should determine whether calculated actual water consumption or nominal water consumption are used.

Calculated actual water consumption should be used when:

- estimating the building's average and total water consumption; and
- estimating the impact of changing a building's water terminal fitting specification on total water consumption.

Nominal water consumption should be used when:

- indicating water efficiency of the building;
- comparing the building to other buildings of the same type; and
- calculating the consumption of an individual terminal fitting.

4.2 Calculated actual water consumption

The calculated actual water consumption for the building should be calculated using actual occupancy and product performance data for the building, see **4.7**. Frequency and intensity of use factors for the building should also be used within these calculations.

NOTE 1 Where this data and actual product performance data is not available, default performance data may be used as provided in Table B.1.

All calculations in Clause **4** should be carried out to two decimal places.

NOTE 2 The calculated actual water consumption is not comparable with in-use metered consumption as metered consumption data can include additional water usage, e.g. irrigation, building services, process water. Metered water consumption can demonstrate a more dynamic situation due to occupant behaviour, which can vary from the assumptions used for calculated actual water consumption in this British Standard.

4.3 Nominal water consumption

Where comparability between buildings is required, the nominal water consumption should be calculated using default occupancy values and frequency and intensity of use factors for similar building types, see **4.7** and, for examples, Annex A. Where available, product performance data that reflects actual terminal fittings in the building should be obtained.

NOTE The default factors in Annex B may be used to calculate nominal water consumption.

4.4 Product performance data

The performance of terminal fittings should be determined in accordance with **4.7**. Product manufacturer's performance data should be obtained or default values used if manufacturer's performance data is not available.

NOTE Manufacturer's product performance data is most relevant for new terminal fittings. For existing terminal fittings, if product performance data is not available, default values based on age and type of terminal fittings may be used.

4.5 Frequency and intensity of use factors

*COMMENTARY ON **4.5***

The frequency of use factor represents the number of uses per person per day for terminal fittings.

The intensity of use factor is applied to terminal fittings where the consumption per use is not fixed and is dependent on user behaviour. The terminal fittings affected include taps and showers where the volume per use is dependent on the duration of use, and also the proportion of total flow rate per use.

For WCs, urinals and other fixed volume terminal fittings, the intensity of use in this British Standard is set at a value of ×1 as there is no user impact on volume per use. The impact of double flushing can be accounted for in the frequency of use factor.

The use of each terminal fitting should be determined by the intensity and frequency of use factor. Actual duration and frequency of use factors for the building should be used if available. Alternative use factors, if available, should be used in accordance with Clause **7**.

NOTE Recommended intensity and frequency of use factors may be used from Table B.2, Table B.3 and Table B.4.

4.6 Occupancy data

Occupancy data should be identified and documented for the building as follows:

a) number of staff, residents and visitors;

b) hours of operation for the building per day;

c) average hours of occupation for staff and residents per day;

d) average duration of stay per visitor per day; and

e) male to female ratio of staff, residents and visitors.

Where occupancy data is unavailable, occupancy data (occupants per m^2) should be obtained from another building of the same building type, size and function, e.g. office areas, staff restaurant and workshop/laboratory areas.

NOTE 1 For calculated actual consumption where actual occupancy data for the building is unavailable, the recommended defaults in Table B.1 may be used.

Where a building contains multiple function areas, the occupancy of each function area should be added together to calculate the total number of occupants for both staff and visitors. This should be calculated for each occupant type as follows:

$$N_O = \sum \{(m^2 \text{ of function area A} \times D_O) + (m^2 \text{ of function area B} \times D_O) + (\text{etc...})\} \quad (1)$$

where:

N_O is the total occupancy of the building for any given working day;

D_O is the default occupancy for a building function type per m^2, examples of which are given in Table B.1.

NOTE 2 Table B.1 may be used to provide recommended default occupancy data for function areas in a building based on floor area.

The m^2 of the function area should be the total occupied internal floor area of the given function, e.g. the total internal floor area of all office areas.

NOTE 3 Where calculating nominal water consumption, the values provided in Table B.1 may be used. Table B.1 is not comprehensive, but provides recommended default occupancy data for the most common non-domestic building types. Occupancy data is used to calculate the total water consumption for the building per annum. Occupancy data may also be used to calculate water consumption per person per day for an individual terminal fitting. BS 6465-1+A1 provides assumptions for building occupancy, which may be used in addition to Table B.1.

4.7 Calculating water consumption of terminal fittings

4.7.1 General

The consumption of each terminal fitting should be calculated in litres per person per day using the equations in **4.7.2** to **4.7.11** and **4.8**, examples of which are given in Annex A.

To calculate water consumption, the performance of terminal fittings should be determined. Where the make of the terminal fitting is known, the performance should be determined using standardized performance data from manufacturer's product information, see performance subclauses of **4.7.2** to **4.7.11**. Manufacturer's product performance data should be based upon the testing requirements set out within the relevant British Standard, see Table 1.

NOTE 1 Where the make of the terminal fitting is unknown and manufacturer's product information is not available, the default values set out in Table B.7 may be used. Where the terminal fitting type is unknown, the highest default value from Table B.7 may be used.

Table 1 **Product performance data**

Terminal fitting	Type	Performance measure	Reference testing standard
WCs	All	Effective flushing volume	The Water Fittings Regulations [1]
Urinals	Flush per use system	Flush volume in litres per use	BS EN 14055
	Controlled system	Flushing frequency per hour and cistern capacity	BS EN 14055
Taps	All	Flow rate in litres per minute	BS EN 200
Showers	All	Flow rate in litres per minute	BS EN 1111 BS EN 1287 BS EN 817 BS EN 1286 BS EN 200
Baths	All	Volume to overflow in litres	Market transformation programme, *Baths – water efficiency performance tests* [2]
Dishwashers	Domestic	Volume per cycle	BS EN 50242 (BS EN 60436)
Washing machines	Domestic	Volume per cycle	BS EN 60456
Softeners	All	Litres of regeneration water consumed per day	BS EN 14743+A1

NOTE 2 The post-2001 installation default values for WCs and urinals are based on the requirements of the Water Fittings Regulations [1]. Where these are superseded, the default values may be taken from the maximum flush volumes set out in the Water Fittings Regulations [1] as amended.

NOTE 3 Manufacturer's product performance data might not always be available, e.g. for existing buildings where historical data is not available, new water terminal fittings not yet specified. Default figures in Table B.7 allow the typical performance of terminal fittings to be indicated based on their type and age.

4.7.2 WCs

4.7.2.1 Performance

The performance of WCs should be determined by the effective flushing volume. For single flush cisterns, the effective flushing volume should be calculated using the total volume of water consumed per flush. For dual flush WCs, the following calculation should be used:

$$\text{effective flushing volume} = \sum \frac{\{(\text{volume at full flush} \times 1) + (\text{volume at part flush} \times 2)\}}{3} \quad (2)$$

NOTE For dual flush WCs, this includes the flushing volume in litres for the cistern at both full and part flushes.

Manufacturer's data should be obtained to specify the full flushing volume in litres for the cistern.

To determine the flushing volume of WCs, the test methods specified in BS EN 997 should be used.

4.7.2.2 Calculation

The following equation should be used to determine the water consumption of WCs:

$$C = EF \times UF \times IU \times MF_R \quad (3)$$

where:

- C is the consumption in litres per person per day (L);
- EF is the effective flushing volume (L);
- UF is the frequency of use factor (uses per person per day);
- IU is the intensity of use factor (duration or percentage of capacity);
- MF_R is the male to female ratio (%).

Where urinals are present, the consumption of WCs should be calculated separately for males and females and added together to calculate the total consumption.

For the calculated actual consumption, an actual male to female ratio should be used for the building if available. Where urinals are not present, the male to female ratio should be given as 1 to demonstrate an equal use of WCs per day for both male and female users.

NOTE 1 The frequency of use factor for WCs is the average number of times a WC is used per person per day. This assumes a relatively constant use of WCs throughout the year and does not take into account peaks and troughs in water usage.

NOTE 2 The male to female ratio is taken into account for WCs to reflect the presence of urinals. The frequency of use factor for WCs is dependent on whether urinals are present or not, showing a higher frequency of use where urinals are not present.

4.7.2.3 Flush-free WCs

Flush-free WCs should be assumed to have zero water consumption.

NOTE Flush-free WCs, such as composting toilets, have zero water consumption per use, but they might require minimal volumes of water for cleaning purposes.

4.7.3 Urinals

4.7.3.1 Performance

The performance of urinals should be determined by their type and specified as the volume in litres per flush per bowl.

For use-activated flush control urinals, the litres per flush per bowl should be determined from manufacturer's data derived from the test method set out in BS EN 13407.

NOTE Use-activated flush control urinals operate on a flush per use basis and include urinals that are both manually operated on a flush per use basis or operated by proximity detection.

For automatic flush control urinals, the litres per flush per bowl and the number of flushes per hour should be determined from manufacturer's data.

4.7.3.2 Calculation

4.7.3.2.1 Urinals – automatic flush control

The following equation should be used to determine the water consumption of urinals with automatic flush control:

$$C = \frac{EF \times Q_C \times HO \times FH}{N_O} \qquad (4)$$

where:

C is the consumption in litres per person per day (L);

EF is the flushing volume (L);

NOTE 1 The flushing volume for urinals is the average flushing volume per urinal bowl. Where a flushing system serves multiple urinal bowls, the flushing volume is the average flushing volume per urinal bowl.

QC is the number of urinal bowls served by the system;

HO is the operating hours;

NOTE 2 The operating hours may be taken from the default values provided in Table B.1 to calculate the nominal water consumption for the building type.

FH is the number of flushes per hour;

N_O is the total number of occupants.

NOTE 3 Where calculating total urinal usage for a building or unit, it is not necessary to divide by the total number of occupants.

The actual operating hours should be used to calculate the actual water use for the building if available.

4.7.3.2.2 Urinals – use-activated flush control

The following equation should be used to determine the water consumption of urinals with use-activated flush control:

$$C = EF \times UF \times IU \times MN_O \times PF \qquad (5)$$

where:

C is the consumption in litres per person per day (L);

EF is the flushing volume (L);

UF is the frequency of use factor (uses per person per day);

IU is the intensity of use factor (duration or percentage of capacity);

MN_O is the male occupancy (%);

PF is the total number of urinal bowls served by the flushing system.

NOTE 1 Use-activated flush control systems do not use timers, but are operated by the user. This includes urinals operated by sensing devices on a flush per use type basis.

NOTE 2 The flushing volume for urinals is the average flushing volume per urinal bowl. Where a flushing system serves multiple urinal bowls, the flushing volume is the average flushing volume per urinal bowl.

4.7.3.2.3 Flush-free urinals

Flush-free urinals should be assumed to have zero water consumption per use with a minimum volume per person per day for cleaning. The minimum volume for cleaning should be in accordance with manufacturer's recommendations and calculated on a per person per day basis. Where manufacturer's recommendations are not available, a default volume of 0.27 litres per urinal bowl per day should be assumed for cleaning.

4.7.4 Taps – wash basin and kitchen sink taps

4.7.4.1 Performance

The performance of taps should be determined by the flow rate of each tap or water outlet with the tap fully open and the flow rate corresponding to a reference pressure. For taps for Type 1 supply systems, the reference pressure is (0.3 + 0.02) MPa [(3.0 + 0.2) bar]. For taps for Type 2 supply systems, the reference pressure is (0.01 ±0.002) MPa [(0.1 ±0.02) bar] in accordance with BS EN 200.

For controlled taps with a timed auto shutoff mechanism (including non-concussive [percussion] taps and taps with sensory devices or capacitance active taps), the duration of use should be determined from manufacturer's product information as an alternative to the intensity of use factor expressed in minutes. For manually operated taps without timed auto shutoff, the duration of use should be determined by the terminal fitting use factor for taps as defined in Clause **7**.

4.7.4.2 Calculation

The following equation should be used to determine the water consumption of wash basins and kitchen sink taps:

$$C = FR \times UF \times IU \qquad (6)$$

where:

C is the consumption in litres per person per day (L);

FR is the flow rate (L/min);

UF is the frequency of use factor (uses per person per day);

*NOTE The frequency of use factor for taps is the number of uses per day. The intensity of use factor for taps shows the duration of use in minutes. It also shows the percentage of maximum flow rate used in the operation of the tap. Kitchen and wash basin taps use the same calculation method. However, different frequency and intensity of use factors are applied to represent the different functional requirements for each terminal fitting type. The frequency and intensity of use factors included in **4.7.4.2** exclude fixed usage, which is determined in **4.7.10**.*

IU is the intensity of use factor (duration or percentage of capacity).

The following equation should be used to determine the water consumption of non-concussive taps as they provide a set volume of water:

$$C = V \times UF \quad (7)$$

where:

V is the total volume of water provided by the non-concussive tap (L).

4.7.5 Showers

4.7.5.1 Performance

The performance of showers should be measured using the flow rate of each shower at the outlet, at 38 °C in accordance with the relevant standard as listed in Table 1.

4.7.5.2 Calculation

The following equation should be used to determine the water consumption of showers:

$$C = FR \times UF \times IU \quad (8)$$

where:

C is the consumption in litres per person per day (L);

FR is the flow rate (L/min);

UF is the frequency of use factor (uses per person per day);

IU is the intensity of use factor.

NOTE The frequency of use factor for showers is the number of uses per person per day. This frequency of use is dependent on the presence of a fitness suite and a bath in the building, see Table B.5. The intensity of use factor is the duration in minutes per shower use.

For showers with multiple shower heads, the average consumption should be calculated using the equation in **4.8**.

4.7.6 Baths

4.7.6.1 Performance

The performance of a bath should be determined by the volume, specified as 100% of the total volume of the bath measured to the mid-point of the overflow. The total volume should be determined from the manufacturer's product data.

NOTE Manufacturer's product data often quotes bath volumes at either 40% or 100% of the total volume of the bath. A quote of 40% of the volume usually incorporates the displacement factor.

The terminal fitting use factor in Clause **7** should be used to take into account the displacement factor.

The manufacturer should be consulted where a bath is quoted at a volume of less than 90 litre capacity as this might indicate that a displacement factor of 40% has been factored into the total volume.

4.7.6.2 Calculation

The following equation should be used to determine the water consumption of baths:

$$C = V \times UF \times IU \qquad (9)$$

where:

C is the consumption in litres per person per day (L);

V is the total volume of the bath to overflow (L);

UF is the frequency of use factor (uses per person per day);

IU is the intensity of use factor.

NOTE The frequency of use factor for baths is the number of baths per day and is dependent on the presence of a shower, see Table B.2. The intensity of use factor is given as a default factor of 0.4. This is the proportion of a bath's total capacity used per bath, also referred to in manufacturer's product literature as the displacement factor.

4.7.7 Dishwashers

4.7.7.1 Performance

*COMMENTARY ON **4.7.7.1***

Attention is drawn to the EU energy label implemented under EU Directive 2010/30/EU [3] and EU Directive 97/17/EC [4]. Water consumption is displayed on the EU energy label as litres per year or litres per cycle respectively. The 2010 Directive [3] uses annual water consumption (AWC) in litres per year rounded up to the nearest integer, based on 280 standard cleaning cycles per annum. Where the EU energy label displays the water consumption in litres per year as implemented under the 2010 Directive [3], the litres per standard washing cycle may be calculated as follows:

$$\text{litres per standard cycle} = \frac{\text{litres per year}}{280} \qquad (10)$$

The 1997 Directive [4] labels dishwashers on a scale of A to G, quoting the consumption in litres per standard cycle. The 2010 Directive [3] labels dishwashers on a scale of A+++ to D, quoting the water consumption in litres per year. The consumption of dishwashers is tested in accordance with BS EN 50242 (BS EN 60436).

The performance of dishwashers should be measured in litres per place setting. This should be determined from the litres per cycle displayed on the EU energy label as follows:

$$LPS = \frac{L_{PC}}{N_O PS} \qquad (11)$$

where:

LPS is the litres per place setting (L);

L_{PC} is the litres per cycle (L);

$N_O PS$ is the number of place setting.

4.7.7.2 Calculation

The following equation should be used to determine the water consumption of dishwashers:

$$C = L_{PC} \times UF \times IU \quad (12)$$

where:

C is the consumption in litres per person per day (L);

L_{PC} is the litres consumed per place setting (L);

UF is the frequency of use factor (uses per person per day);

IU is the intensity of use factor.

NOTE The use factor for dishwashers in staff restaurants is the number of uses per cover per m². The use factor for dishwashers in staff kitchens/kitchenettes is the number of place settings per occupant per day. The intensity of use factor is the average number of place settings per cycle.

4.7.8 Washing machines

4.7.8.1 Performance

*COMMENTARY ON **4.7.8.1***

Attention is drawn to the EU energy label implemented under EU Directive 2010/30/EU [3] and EU Directive 92/75/EEC [5]. Water consumption is displayed on the EU energy label as litres per year or litres per cycle respectively. The 2010 Directive [3] uses the weighted annual water consumption (AWC) in litres per year rounded up to the nearest integer, based on 220 standard washing cycles for cotton programmes at 60 °C and 40 °C at full and partial load. Where the EU energy label displays the water consumption in litres per year as implemented under the 2010 Directive [3], the litres per standard washing cycle may be calculated as follows:

$$\text{litres per standard cycle} = \frac{\text{litres per year}}{220} \quad (13)$$

The 1992 Directive [5] labels washing machines on a scale of A to G, quoting the consumption in litres per standard cycle. The 2010 Directive [3] labels washing machines on a scale of A+++ to D, quoting the water consumption in litres per year. The consumption of washing machines is tested in accordance with BS EN 60456.

The performance of washing machines should be measured in litres per kilogram. This should be determined from the litres per cycle as displayed on the EU energy label as follows:

$$L_{KG} = \frac{L_{PC}}{C_{KG}} \quad (14)$$

where:

L_{KG} is the litres per kilogram (L/kg);

L_{PC} is the litres per cycle (L);

C_{KG} is the total capacity of the washing machine in kilograms (kg).

4.7.8.2 Calculation

The following equation should be used to determine the water consumption of washing machines:

$$C = L_{KG} \times UF \times IU \quad (15)$$

where:

C is the consumption in litres per person per day (L);

L_{KG} is the litres consumed per kilogram (L/kg);

UF is the frequency of use factor (uses per person per day);

IU is the intensity of use factor.

NOTE The intensity of use factor is the average number of kilograms per cycle.

4.7.9 Waste disposal unit

4.7.9.1 Performance

The flow rate of the waste disposal unit should be determined by the flow rate of the tap supplying the waste disposal unit, see **4.7.4.1** for tap performance. The performance of waste disposal units should be measured in flow rate in litres per minute.

NOTE BS 5906 provides guidance for waste management in buildings.

4.7.9.2 Calculation

The following equation should be used to determine the water consumption of waste disposal units:

$$C = \frac{FR \times IU}{N_O} \qquad (16)$$

where:

C is the consumption in litres per person per day (L);

FR is the flow rate (L/min);

IU is the intensity of use factor (duration or percentage of capacity);

N_O is the number of occupants.

4.7.10 Calculating water consumption based upon fixed domestic water usage

NOTE There are no performance subclauses for fixed domestic water usage as water consumption is fixed and not dependent upon performance of the terminal fitting.

4.7.10.1 Fixed usage – Drinking

The fixed usage should be adjusted according to the occupancy of the building using the following equation:

$$C = \frac{FU}{HR} \times O_{HR} \qquad (17)$$

where:

C is the consumption in litres per person per day (L);

FU is the fixed usage for a 24-hour day in litres per person per day (L);

HR is the total number of hours in a day (hrs);

O_{HR} is the default or actual operating hours for the building (hrs).

NOTE A fixed usage is assumed per person per day to demonstrate a minimum volume of water required for drinking.

4.7.10.2 Fixed usage – food preparation and cooking

The following equation should be used to determine the fixed water usage for food preparation:

$$C = \frac{NFA \times C_{NO} \times W_{FP}}{N_O} \quad (18)$$

where:

- C is the consumption in litres per person per day (L);
- NFA is the net floor area of the restaurant (m^2);
- C_{NO} is the number of covers in the restaurant floor area (m^2);
- W_{FP} is the water used for food preparation and cooking per cover (L);
- N_O is the number of occupants.

NOTE The fixed usage for food preparation and cooking includes the water used in food preparation and food preparation sink usage. It excludes process water used for food manufacturing.

4.7.10.3 Fixed usage – kitchen cleaning

The following equation should be used to determine the fixed water usage for kitchen cleaning:

$$C = \frac{NFA \times C_{NO} \times W_{KC}}{N_O} \quad (19)$$

where:

- C is the consumption in litres per person per day (L);
- NFA is the net floor area of the restaurant (m^2);
- C_{NO} is the number of covers in the restaurant floor area (m^2);
- W_{KC} is the water used for kitchen cleaning;
- N_O is the number of occupants.

NOTE The fixed usage for kitchen cleaning includes the water used for pot and pan cleaning, and for general kitchen cleaning. It excludes water used by dishwashers and washing machines.

4.7.11 Softeners

4.7.11.1 Performance

The performance of softeners should be determined by the volume of regeneration water consumed per regeneration process, the number of regenerations per day and the volume of water treated between two regenerations. This should be obtained from manufacturer's product information derived from the test method set out in BS EN 14743+A1.

4.7.11.2 Calculation

The following equation should be used to determine the water consumption of softeners:

$$CT = \left(1 - \frac{4}{PC}\right) \times \left(RC \times N_O R\right) \quad (20)$$

where:

CT is the total water consumption of softened water per person per day (L);

PC is the percentage of total capacity used per regeneration process (%);

RC is the litres of regeneration water consumed for each regeneration process (L);

N_OR is the average number of regeneration processes carried out per day.

The following equation should be used to determine the water consumption of softened water per person per day:

$$C = \frac{CT}{N_O} \qquad (21)$$

where:

C is the total water consumption of softened water per person per day (L);

CT is the total water consumption of softened water per day (L);

N_O is the total number of occupants served by the softener.

The following equation should be used to determine the percentage of total capacity used per regeneration:

$$PC = \left(\frac{RC}{VR}\right) \times 100 \qquad (22)$$

where:

PC is the percentage of total capacity used per regeneration process (%);

RC is the litres of regeneration water consumed for each regeneration process (L);

VR is the volume of water treated between two regenerations (L).

Where rainwater is supplied to the building, the volume of softened water should exclude the rainwater yield, as calculated in accordance with **5.3**.

NOTE 1 The volume of water treated between two regenerations relates to the exchange capacity of the softening unit. BS EN 14743+A1 defines the exchange capacity of the softening unit, expressed in grams of calcium carbonate, fixed by the softener between the end of the last regeneration and the beginning of the exhaustion of the resin. The volume of water treated between two regenerations is the exchange capacity of the softening unit, expressed in litres of water softened. Attention is also drawn to the WRAS information and guidance note, "No 9-07-01, Information for Installation of Ion Exchange Water Softeners for Systems Supplying Water for Domestic Purposes" [1)] *[6].*

NOTE 2 The consumption of water softeners is calculated as the consumption beyond a level of best practice, defined as water softeners which consume a volume of water per regeneration process that is equal to or less than 4% of their total volume of water treated between two regenerations. The consumption is calculated as the volume of water consumed beyond the 4% best practice level. Where the percentage is calculated as less than 4%, the water consumption of the water softener is expressed as zero.

1) http://www.wras.co.uk/PDF_Files/IGN9-07-01.pdf

4.8 Average water consumption

Where there are multiple terminal fittings of each fitting type which vary in performance, the average performance of each should be calculated. The consumption of each terminal fitting type should be calculated using the relevant equations from **4.7**. The following equation should be used to determine the average consumption for these terminal fitting types:

$$C_{AVG} = \frac{\sum \{(C_A \times N_{OF}A) + (C_B \times N_{OF}B) + \text{etc.}\}}{N_{OT}} \quad (23)$$

where*:*

C_{AVG} is the average consumption of the specific terminal fitting types (e.g. taps) (L);

C_A is the consumption of terminal fitting type A (calculated in **4.7.2** to **4.7.11**) (L);

$N_{OF}A$ is the number of terminal fittings of type A;

C_B is the consumption of terminal fittings type B (calculated in **4.7.2** to **4.7.11**) (L);

$N_{OF}B$ is the number of terminal fittings of type B;

N_{OT} is the total number of all terminal fitting types.

Where there are taps with various flow rates, the per capita consumption of each tap should be calculated and the above calculation used to calculate the average per capita consumption of the taps.

Where the frequency and intensity of use factor for a terminal fitting type varies between staff and visitors, the average consumption of each fitting type should be calculated separately for staff and visitors.

5 Rainwater and greywater

5.1 Net volume

Total water consumption calculated in Clause **6** should include the net savings from rainwater and greywater. This should be calculated by using the rainwater and greywater yield and the unwholesome water demand. The net savings should not exceed the volume of water available (the yield) nor the unwholesome water demand.

All calculations in Clause **5** should be carried out to two decimal places.

The following equation should be used to calculate the net savings from rainwater and greywater:

When

$$R \leq N \quad (24)$$

$S = R$.

When

$$R \geq N \quad (25)$$

$S = N$.

where:

R is the gross volume of rainwater and greywater available (L);

N is the gross unwholesome water demand (L);

S is the net savings from rainwater and greywater (L).

NOTE The net savings from greywater and rainwater are limited by the volume of rainwater and greywater available, and the unwholesome water demand. Where the demand is greater than the supply, the savings are limited to the available supply. Where the supply is greater than the demand, the savings are limited to the demand.

5.2 Unwholesome water demand

*COMMENTARY ON **5.2***

BS 8515 provides a generic domestic-unwholesome water demand through the year of 50 litres per person per day for WC flushing and clothes washing, referred to as the non-potable water demand. This is used for sizing rainwater harvesting systems in BS 8515 with the simplified and intermediate approach.

This British Standard does not use the unwholesome water demand set out in BS 8515, but provides a detailed approach for calculating the unwholesome water demand of a non-domestic building. This standard calculates the demand of the specific terminal fittings provided in the building and the building type. This assumes a constant unwholesome water demand and excludes usage peaks. However, it is specific to the terminal fittings in the building and the type of building.

The unwholesome water demand should be calculated for WCs, urinals, and domestic and commercial scale washing machines (Clause **4**). It should include all terminal fittings to be supplied by greywater or rainwater. Where only some terminal fittings are to be supplied with rainwater or greywater, the percentage of terminal fittings supplied should be calculated.

NOTE The total unwholesome water demand is the demand of the terminal fittings being supplied with rainwater or greywater.

The following equation should be used to determine the total unwholesome water demand:

$$GP = \sum \left\{ \left(G_{WC} \times P_{WC} \right) + \left(G_U \times P_U \right) + \left(G_{WM} + P_{WM} \right) \times 365 \right\} \quad (26)$$

$$GPT = \frac{GP}{365} N_o \quad (27)$$

where:

GP is the gross unwholesome water demand per person per year (L);

G_{WC} is the gross water consumption for WCs per person per day (L);

P_{WC} is the percentage of WCs being supplied by unwholesome water (%);

G_U is the gross water consumption for urinals per person per day (L);

P_U is the percentage of urinals being supplied by unwholesome water (%);

G_{WM} is the gross water consumption for domestic and commercial scale washing machines per person per day (L);

P_{WM} is the percentage of washing machines being supplied by unwholesome water (%);

GPT is the total gross unwholesome water demand per year (L);

N_o is the number of occupants.

5.3 Rainwater yield

The rainwater yield should be used to determine the volume of water available from rainwater.

The following equation should be used to determine the rainwater yield per person per day:

$$R_Y T = \frac{(C \times Y_{CE} \times R \times H_{FE})}{(365 \times N_O)} \quad (28)$$

where:

$R_Y T$ is the total rainwater yield per person per day (L);

C is the collection area (m^2);

Y_{CE} is the yield co-efficient;

R is the average annual rainfall (mm);

H_{FE} is the hydraulic filter efficiency (%);

N_O is the total occupancy.

*NOTE This calculation methodology for total rainwater yield is similar to the method described in BS 8515:2009, **4.1.2.3**, but provides the rainwater yield per person per day rather than 5% of the annual yield.*

Where the detailed approach described in BS 8515:2009, **4.1.4** has been used to determine the rainwater yield, the value obtained should be converted to the total average rainwater yield per annum.

5.4 Greywater yield

*COMMENTARY ON **5.4***

*Attention is drawn to BS 8525-1. The simplified approach in Clause **4** provides demand and yield values for single domestic properties. The detailed approach provides typical values for shower and tap flow rates and bath and washing machine capacities as well as typical use factors. The values provided in BS 8525-1 are typical values and largely based on residential buildings. This British Standard uses more specific values typical for domestic use in non-domestic buildings providing values to be used instead of the typical values provided in BS 8525-1.*

The greywater yield should be calculated as described in the detailed approach set out in BS 8525-1. However the typical use factors should be taken from the performance subclauses of **4.7**. The greywater yield comprises the volume of water collected by the greywater system that should include the following terminal fittings where present:

a) showers and baths;

b) wash basins; and

c) washing machines.

Yield and demand should be calculated using product performance data defined in the performance subclauses of **4.7** and use factors defined in Clause **7**.

6 Total calculated water consumption

6.1 Gross water consumption per capita

Gross water consumption per capita should be calculated using the relevant equations in **4.7** for each terminal fitting in the building. Where there is more than one type of each terminal fitting, an average consumption should be calculated using the equation in **4.8**.

Total water consumption in Clause **6** should be calculated to one decimal place.

It is recommended that the gross water consumption is calculated for the actual terminal fittings and the baseline terminal fittings, see Table B.6 for examples, to provide a comparison of actual performance with typical performance.

Once the consumption of each terminal fitting has been calculated (**4.7**), the following equations should be used to determine the actual gross water consumption:

$$GPCC = \sum (C_1 + C_2 + \text{etc.}) \quad (29)$$

$$GPA = \frac{GPCC \times ADO \times N_O}{1000} \quad (30)$$

where:

GPCC is the gross per capita consumption (L);

C_1 is the consumption of terminal fitting type 1;

C_2 is the consumption of terminal fitting type 2;

GPA is the gross water consumption per annum in m^3;

ADO is the annual days of operation for the building;

N_O is the number of occupants.

NOTE 1 Annex B provides example calculation tables for calculating water consumption in three example buildings including an office, and retail and industrial buildings.

NOTE 2 The gross actual water consumption is a calculated water consumption figure for the building based on the building terminal fittings, occupancy figures, and assumed average frequency and intensity of use factors for the building type. The gross calculated water consumption does not reflect the operational water consumption for the specific building due to the impact of occupant behaviour, which cannot be predicted by a calculation methodology. Operational performance may be determined through water metering, either on a whole building level or on a terminal fittings level.

6.2 Total net water consumption

Once the gross water consumption has been calculated, the total net water consumption should be calculated where greywater or rainwater is provided for the building or where the total water consumption is required. The following equations should be used to determine the total net water consumption:

$$NPCC = GPCC - S \quad (31)$$

$$NPA = GPA - (S \times N_O) \quad (32)$$

where:

NPCC is the net water consumption per person per day;

GPCC is the gross per capita consumption (L);

S is the net savings from rainwater and greywater in litre per person per day (L);

NPA is the net water consumption per annum;

GPA is the gross water consumption per annum in m^3;

N_O is the number of occupants.

7 Terminal fitting use factors

To calculate the gross water consumption in accordance with **4.7** and **6.1**, terminal fitting use factors should be determined for the building.

NOTE Table B.2, Table B.3 and Table B.4 may be used to provide recommended default use factors for offices, and retail and student accommodation buildings.

Where available, the actual use factors for the building should be used to calculate the actual water consumption. Where a nominal comparison of the water efficiency of a group of buildings (e.g. office buildings) based on the performance of their terminal fittings is required, the same set of use factors should be used to calculate the water consumption of each building to ensure a fair comparison.

All terminal fitting data should be based on the mean average usage per person per day.

Where actual use factor data is not available, research should be developed to identify suitable terminal fitting use factors. Use factor research should be subject to credible and independent peer review to ensure that it has been carried out using sound scientific principles. This peer review should be documented and the research should include the following.

- A sampling methodology demonstrably based on sound science and statistics.
- A sampling period and sample size representative of the building type, and the range and patterns of expected water use.
- An evaluation of the impact of user behavior applied to the use factors. Where the range of impact is considered to be significant, higher water consumption and frequency factors should be assumed and documented in the water use calculations.

8 Domestic water consumption performance indicators

Performance indicators should be identified for the building to compare the building's calculated water consumption.

Performance indicators based on the calculated water consumption for similar building types should be used to compare the building's calculated water consumption against other buildings. Performance indicators for the building should be developed by identifying target performance indicators for each terminal fitting. They should be calculated in accordance with Clause **4** using target performance indicators for each terminal fitting instead of the actual performance of terminal fittings.

*NOTE 1 The terminal fitting performance indicators given in Table B.6 may be used in the water calculation to develop target performance indicators for each specific building type in accordance with Clause **4**. Table B.8 may be used to provide example performance indicators for an example office building.*

NOTE 2 AECB Water Standards, "Delivering buildings with excellent water and energy performance" [7], BRE, "BREEAM New Construction 2011. Non-Domestic Buildings: Technical Manual" [8] and the Bathroom Manufacturers Association, "Water Efficiency Product Labelling Scheme" [2)] *[9] provide references for developing water consumption performance indicators.*

[2)] http://www.water-efficiencylabel.org.uk/

Annex A (informative) Example calculations – Office buildings: baseline calculation

COMMENTARY ON ANNEX A

Annex A, Tables A.1 to A.10, provides examples of how the standard may be used to calculate water consumption in office buildings using the baseline performance indicators from Table B.6.

Where urinals are not present, WC usage for males and females is not calculated separately.

*For column (1), the performance subclauses in **4.7** may be used to determine the actual performance of terminal fittings. Where actual performance is not available, default performance data may be obtained from Table B.7. Where calculating water efficiency indicators for the building type, performance data may be obtained from Table B.6.*

Table A.1 **Water consumption calculator for offices: WCs**

Terminal fitting type – WCs L	**(1) Performance** [A)]	**(2) Frequency of use** [B)]	**(3) Intensity of use** [C)]	**(4) Male to female ratio** [D)]	**(5) Litres/person/day** [E)] **=(1)×(2)×(3)×(4)**
WC (male) – effective flushing volume	6	1	1	0.5	3.0
WC (female) – effective flushing volume	6	4	1	0.5	12.0
				(a) = ∑ **(5)**	**15.0**

[A)] For calculating performance, see **4.7.2.1**, examples are given in Table B.6 and Table B.7.

[B)] For the frequency of use, see Clause **7**, examples are given in Table B.2.

[C)] For the intensity of use, see Clause **7**, examples are given in Table B.2.

[D)] The male to female ratio is based upon actual occupancy data, see **4.6**.

[E)] For calculating the litres/person/day, see **4.7.2.2**.

Table A.2 **Water consumption calculator for offices: urinals**

Terminal fitting type – urinals	**(1) Performance** [A)] L	**(2) Number of urinal pans** [B)]	**(3) Number of flushes/hr** [C)]	**(4) Operating hours** [D)]	**(5) Total occupancy** [E)]	**(6) Litres/person/day** [F)] **=(1)×(2)×(3)×(4)/(5)**
Automatic flush control	3.75	5	1	9	120	1.41
	(1) Performance [A)] L	**(2) Number of urinal pans** [B)]	**(3) Frequency of use factor** [G)]	**(4) Intensity of use factor** [H)]	**(5) Male occupancy (%)** [I)]	**(6) Litres/person/day** [F)] **=(1)×(2)×(3)×(4)×(5)**
Use-activated flush control	3.75	2	3	1	50%	11.25
					(b) = $\sum$ **(6)**	**12.66**

[A)] For calculating performance, see **4.7.3.1**, examples of which are given in Table B.6 and Table B.7.

[B)] For the number of urinal pans, see **4.7.3.1**.

[C)] For the number of flushes per hour, see **4.7.3.1**.

[D)] For operating hours, see **4.6**, examples of which are given in Table B.1.

[E)] For calculating total occupancy, see **4.6**, examples of which are given in Table B.1.

[F)] For calculating the litres/person/day, see **4.7.3.2.1**.

[G)] For the frequency of use, see Clause **7**, examples of which are given in Table B.2.

[H)] For the intensity of use, see Clause **7**, examples of which are given in Table B.2.

[I)] Male occupancy is based upon actual occupancy data, see **4.6**.

Table A.3 **Taps (personal hygiene)**

Taps (personal hygiene) L/min	**(1) Flow rate**	**(2) Use factor – frequency of use** [A]	**(3) Use factor – intensity of use** [B]	**(4) Litres/person/day =(1)×(2)×(3)**
Taps – excluding kitchen/utility room taps	12 [C]	4	0.25	12 [D]
Shower	14 [E]	0.03	5.6	2.35 [F]
Fixed use – drinking	NA	NA	NA	2.5 [G]
			(c) = ∑ **(4)**	**16.85**

[A] For the frequency of use, see Clause **7**, examples of which are given in Table B.2.

[B] For the intensity of use, see Clause **7**, examples of which are given in Table B.2.

[C] For calculating tap flow rate, see **4.7.4.1**, examples of which are given in Table B.6 and Table B.7.

[D] For calculating the litres/person/day for taps, see **4.7.4.2**.

[E] For calculating shower flow rate, see **4.7.5.1**, examples of which are given in Table B.6 and Table B.7.

[F] For calculating the litres/person/day for showers, see **4.7.5.2**.

[G] For calculating the litres/person/day for fixed use (drinking), see **4.7.10.1**.

Table A.4 **Taps (staff kitchen – cleaning)**

Taps (staff kitchen – cleaning) L/min	**(1) Flow rate**	**(2) Usage/person/day** [A]	**(3) Use factor – intensity of use** [B]	**(4) Litres/person/day =(1)×(2)×(3)**
Kitchen taps	12 [C]	1	0.44	5.28 [D]
Dishwasher	1.41 [E]	0.04	12	0.67 [F]
			(d) = ∑ **(4)**	**5.95**

[A] For the usage/person/day, see Clause **7**, examples of which are given in Table B.2.

[B] For the intensity of use, see Clause **7**, examples of which are given in Table B.2.

[C] For calculating performance for kitchen taps, see **4.7.4.1**, examples of which are given in Table B.6 and Table B.7.

[D] For calculating the litres/person/day for kitchen taps, see **4.7.4.2**.

[E] For calculating performance for dishwashers, see **4.7.7.1**, examples of which are given in Table B.6 and Table B.7.

[F] For calculating the litres/person/day for dishwashers, see **4.7.7.2**.

Table A.5 **Kitchen canteen/restaurant: waste disposal**

Taps (kitchen canteen/restaurant) L/min	**(1) Flow rate**	**(2) Use factor – frequency of use** [A)]	**(3) Use factor – intensity of use**	**(4) Number of occupants**	**(5) Litres/person/day** [B)] **=(1)×(2)×(3)×(4)**
Waste disposal	16	30	1	120	4.00
				(e) = ∑ **(5)**	**4.00**

[A)] For the frequency of use, see Clause **7**, examples of which are given in Table B.2.

[B)] For calculating the litres/person/day, see **4.7.9.2**.

Table A.6 **Kitchen canteen/restaurant: food preparation and cleaning**

Fixed usage L	**(1) Water use per cover** [A)] (L)	**(2) Floor area** (m^2)	**(3) Number of covers per m^2**	**(4) Number of occupants**	**(5) Litres/person/day =(1)×(2)×(3)/(4)**
Food preparation water use per cover	2.34	250	0.822	240	2.0 [B)]
Kitchen cleaning water use per cover	4.78	250	0.822	240	4.09 [C)]
				(f) = ∑ **(5)**	**4.09**

[A)] For water use per cover, see **4.7.10.2**, examples of which are given in Table B.2.

[B)] For calculating the litres/person/day for food preparation, see **4.7.10.2**.

[C)] For calculating the litres/person/day for kitchen cleaning, see **4.7.10.3**.

Table A.7 **Kitchen canteen/restaurant: dishwasher**

Fixed usage litres per place setting	**(1) Performance**	**(2) Floor area** (m^2)	**(3) Number of covers per m^2**	**(4) Place settings per cover**	**(5) Number of occupants**	**(6) Litres/person/day** [A)] **=(1)×(2)×(3)×(4)/(5)**
Dishwasher	1.41	250	0.822	0.5	240	0.6
					(g) = ∑ **(6)**	**0.6**

[A)] For calculating the litres/person/day, see **4.7.7.2**.

Table A.8 **Softeners**

(1) Performance [A] %	**(2) Water consumed per regeneration** [B] L	**(3) Average number of regeneration cycles per day** [C]	**(4) Number of occupants served by the system** [D]	**(5) Water consumed above 4%** =1–[4/(1)] [E]	**(6) Litres/person/day** =(2)×(3)×(5)/(4) [F]
10	16	2	120	0.6	
				(h) = ∑ **(6)**	0.16

[A] For calculating performance, see **4.7.11.1**.

[B] For calculating water consumed per regeneration, see **4.7.11.1**.

[C] For the average number of regeneration cycles per day, see **4.7.11.1**.

[D] For the number of occupants served by the system, see **4.6**, examples of which are given in Table B.1.

[E] For water consumed above 4%, see **4.7.11.2**.

[F] For calculating the litres/person/day, see **4.7.11.2**.

Table A.9 **Total water consumption (per capita consumption – occupied days)**

(1) Gross water consumption (actual) [A]	**(2) Water savings** [B] litres/person/day	**(3) Net water consumption** [C] **=(1)–(2)** litres/person/day
$=\sum a+b+c+d+e+f+g$	= S	61.36
	0	

[A] For gross water consumption, see **6.1**, this is the sum total of Tables A.1 to A.8.

[B] For water savings from greywater and rainwater, see **5.1**.

[C] For net water consumption, see **6.2**.

Table A.10 **Total water consumption (m³ per annum per building)**

(1) Gross water consumption (actual) [A]	**(2) Water savings** [B] m^3 per annum	**(3) Net total water consumption** [C] **=(1)–(2)** m^3 per annum
$=\sum (a+b+c+d+e+f+g)\times 240\times 365 / 1000$	= S	3 727.78
	0	

[A] For gross water consumption, see **6.1**, this is the sum total of Tables A.1 to A.8.

[B] For water savings from greywater and rainwater, see **5.1**.

[C] For net water consumption, see **6.2**.

Annex B (informative) Default values for calculating water consumption

COMMENTARY ON ANNEX B

Annex B, Tables B.1 to B.8, provides default factors for calculating water consumption.

Table B.1 **Default occupancy data – staff**

Building type	Days operating/year (default)	Operating hours/day (default)	Occupancy – staff (default) persons/m^2
Offices – office areas	253	9	0.110
Offices – staff restaurant	253	9	0.0 866
Offices – workshop/laboratory areas	253	9	0.0 680
Restaurant – eating and drinking areas	300	10	0.2 000
Restaurant – food preparation areas	300	10	0.1 080
Restaurant – office areas	300	10	0.1 090
Retail – general retail sales areas	310	9	0.1 170
Retail – office areas	310	9	0.0 950
Retail – food preparation area	310	9	0.1 080
Retail – reception area	310	9	0.1 010
Retail – eating/drinking area	310	9	0.3 310
Retail – warehouse sales area	310	9	0.0 530
Retail – goods in and storage area	310	9	0.0 110
Industrial – process area	253	8	0.0 224
Industrial – laboratory	253	8	0.1 069
Industrial – warehouse storage	253	8	0.0 108
Industrial – office areas	253	8	0.0 994
Industrial – staff restaurant	253	8	0.0 803
Hotel – staff	365	24	0.5 per room
Leisure centre	364	14	0.1 170
Pub/club	364	12	0.1 170
Education	253	10	0.1 000

NOTE Further default occupancy data for additional non-domestic buildings types can be obtained from BRE, "The National Energy Calculation Methodology for the Energy Performance of Building Directive")

Table B.2 **Default use factors for office buildings**

Terminal fitting type	Frequency of use factor	Intensity of use factor
WC – male (urinals present)	1	1
WC – male (no urinals present)	4	1
WC – female	4	1
Urinals	3	1
Wash basin taps	4	0.25
Shower use (no fitness suite)	0.03	5.60
Shower use (fitness suite)	0.15	5.60
Kitchen tap – kitchenette	1	0.44
Kitchen tap – pre-rinse nozzle	1	60
Dishwasher – office areas	0.04	12
Fixed usage – drinking	2.5 litres	1
Fixed usage – food preparation	554.29 litres	1
Waste disposal units	30	1
Fixed usage	**Litres per day**	
Pot and pan cleaning	3.6 litres per cover	
Food preparation	1.89 litres per cover	
Food preparation sink usage	0.45 litres per cover	
Cleaning	1.19 litres per cover	
Drinking	2.5 litres per person	
Dishwashers	0.5 place settings per cover	

*NOTE 1 Fixed usage for food preparation and food preparation sink usage may be used with **4.7.10.2** for determining the water used for food preparation and cooking per cover. Fixed usage for cleaning, and pot and pan cleaning may be used with **4.7.10.3** for determining the water used for kitchen cleaning per cover.*

NOTE 2 The following publications were referenced in the compilation of Table B.2:

- *Market transformation programme, "Domestic water consumption in domestic and non-domestic properties", [12];*
- *Department for Transport, "Transport statistics" [13];*
- *Communities and Local Government, "Assessing the costs and benefits of improvements to the water efficiency of new non-household buildings" [14];*
- *Market transformation programme, "Baths – water efficiency performance tests" [2];*
- *Howard and Bartram, "Domestic water quantity, service level and health" [15];*
- *NHS, "Health Survey for England" [16];*
- *Communities and Local Government, "The Water Efficiency Calculator for new dwellings" [17]; and*
- *BRE, "BREEAM New Construction 2011. Non-Domestic Buildings: Technical Manual" [8].*

Table B.3 **Default use factors for retail buildings: visitors**

Terminal fitting type	**Frequency of use factor**	**Intensity of use factor**
WC – male (urinals present)	0.17	1
WC – male (no urinals present)	1	1
WC – female	1	1
Wash basin taps	1	0.25
Urinals	0.83	1
Fixed usage	**Litres per day**	
Pot and pan cleaning	3.6 litres per cover	
Food preparation	1.89 litres per cover	
Food preparation sink usage	0.45 litres per cover	
Cleaning	1.19 litres per cover	

*NOTE 1 Fixed usage for food preparation and food preparation sink usage may be used with **4.7.10.1** for determining the water used for food preparation and cooking per cover. Fixed usage for cleaning, and pot and pan cleaning may be used with **4.7.10.2** for determining the water used for kitchen cleaning per cover.*

NOTE 2 The following publications were referenced in the compilation of Table B.3:

- *Market transformation programme, "Domestic water consumption in domestic and non-domestic properties", [12];*
- *Department for Transport, "Transport statistics" [13];*
- *Communities and Local Government, "Assessing the costs and benefits of improvements to the water efficiency of new non-household buildings" [14];*
- *Market transformation programme, "Baths – water efficiency performance tests" [2];*
- *Howard and Bartram, "Domestic water quantity, service level and health" [15];*
- *NHS, "Health Survey for England" [16];*
- *Communities and Local Government, "The Water Efficiency Calculator for new dwellings" [17]; and*
- *BRE, "BREEAM New Construction 2011. Non-Domestic Buildings: Technical Manual" [8].*

Table B.4 **Default use factors for retail buildings: staff**

Terminal fitting type	**Frequency of use factor**	**Intensity of use factor**
WC – male (urinals present)	3	1
WC – male (no urinals present)	4	1
WC – female	4	1
Wash basin taps	4	0.25
Shower use (no fitness suite)	0.03	5.60
Urinals	1	1
Fixed usage	**Litres per day**	
Fixed usage – drinking	2.5 litres per person	

NOTE The following publications were referenced in the compilation of Table B.4:

- *Market transformation programme, "Domestic water consumption in domestic and non-domestic properties" [12];*
- *Department for Transport, "Transport statistics" [13];*
- *Communities and Local Government, "Assessing the costs and benefits of improvements to the water efficiency of new non-household buildings" [14];*
- *Market transformation programme, "Baths – water efficiency performance tests" [2];*
- *Howard and Bartram, "Domestic water quantity, service level and health" [15];*
- *NHS, "Health Survey for England" [16];*
- *Communities and Local Government, "The Water Efficiency Calculator for new dwellings" [17]; and*
- *BRE, "BREEAM New Construction 2011. Non-Domestic Buildings: Technical Manual" [8].*

Table B.5 **Default use factors for study bedrooms (e.g. in student halls of residence)**

Terminal fitting type	**Frequency of use factor**	**Intensity of use factor**
WC	4.42	1
Wash basin taps	1.58	1
Bath (where shower also present)	0.51	1
Shower (where bath also present)	4.37	1
Bath only	0.90	1
Shower only	5.60	1
Kitchen taps	0.44	1
Washing machine	0.34	6.18
Dishwasher	0.30	12
Fixed usage	**Litres per day**	
Fixed usage – drinking	2.5 litres per person	
Fixed usage – food preparation	10.36 litres per person	

NOTE The following publications were referenced in the compilation of Table B.5:

- *Communities and Local Government, "The Water Efficiency Calculator for new dwellings" [17]; and*
- *Howard and Bartram, "Domestic water quantity, service level and health" [15].*

The Water Efficiency Calculator for new dwellings combines the frequency of use factor and the intensity of use factor as one factor: the "use factor". These factors have been separated to align with use factors for domestic water use in other building types.

The intensity of use factor for washing machines and dishwashers is the average capacity in kilograms and the average number of place settings respectively.

Table B.6 **Performance indicators** [A)]

Component	Baseline [B)]	Fair [C)]	Good [D)]	Excellent [E)]
WC	6 litre effective flushing volume	5 litre effective flushing volume	4 litre effective flushing volume	3 litre effective flushing volume
Urinal	7.5 litres per bowl per hour	6 litres per bowl per hour	1.5 litres per bowl per hour	0 litres per bowl per hour excluding cleaning
Wash basin taps	12 litres per minute	9 litres per minute	4.5 litres per minute	3 litres per minute
Shower	14 litres per minute	10 litres per minute	8 litres per minute	6 litres per minute
Bath (volume to overflow)	200 litres	180 litres	140 litres	140 litres
Kitchen tap	12 litres per minute	10 litres per minute	5 litres per minute	5 litres per minute
Dishwasher (domestic)	1.41 litres per place setting	1.08 litres per place setting	1.00 litres per place setting	0.83 litres per place setting
Washing machines (domestic)	14.5 litres per kilogram	9.7 litres per kilogram	6.47 litres per kilogram	4.85 litres per kilogram
Rainwater harvesting	NA	System installed and supplying 25% of WC and urinal flushing demand	System installed and supplying 50% of WC and urinal flushing demand	System installed and supplying 75% of WC and urinal flushing demand
Greywater recycling	NA	NA	System installed and supplying 25% of WC and urinal flushing demand	System installed and supplying 50% of WC and urinal flushing demand

[A)] Table B.6 is provided as an example for indicating performance in a range of building types. It is not for use in benchmarking the performance of a building at either the component or whole building level.

[B)] Current typical performance in new non-domestic buildings to compare the building against.

[C)] An improvement on current practice.

[D)] Industry good practice performance.

[E)] Best practice water efficiency levels.

NOTE 1 Buildings that have a lower consumption than the baseline have a higher performance than typical practice.

Fair, good and excellent performance indicators allow buildings that perform better than the baseline to be rated in terms of overall water efficiency at the whole building level.

NOTE 2 Table B.6 provides a means of determining whole building performance indicators. The performance indicators for individual fittings are not for use in setting performance indicators for individual terminal fittings.

NOTE 3 The following publications were referenced in the compilation of Table B.6:

- *Grant and Thornton, "AECB Water Standard. Volume 2: The Water Standards, Technical Background Report" [18]; and*
- *BRE. "BREEAM New Construction 2011. Non-Domestic Buildings: Technical Manual" [8].*

Table B.7 **Default performance data for terminal fittings**

Terminal fitting type	Average usage	
Showers	Mixer – traditional mixer	8 litres per minute
	Mixer – integrated power	10 litres per minute
	Mixer – separate pump	12 litres per minute
	Mixer – pressurized systems	12 litres per minute
	Mixer – bath/shower mixers	6 litres per minute
	Electric 7–7.9 kW	3.5 litres per minute
	Electric 8–8.9 kW	4 litres per minute
	Electric 9–9.9 kW	4.6 litres per minute
	Electric 10 kW+	5 litres per minute
Baths	Undersized bath – 1600 mm length	165 litres – volume to overflow
	Corner bath	140 litres – volume to overflow
	Shower bath	250 litres – volume to overflow
	Standard bath	225 litres – volume to overflow
	Roll top bath	205 litres – volume to overflow
	Whirlpool spa baths	225 litres – volume to overflow
WCs	Post 2001	6 litres
	1993–2000	7.5 litres
	Pre-1993	10 litres
Urinals	Pressure flushing (mains fed) systems	1.5 litres per urinal or position per flush
	Cistern flushing systems for a single urinal without use-detection equipment installed	10 litres per hour per urinal bowl
	Cistern flushing systems for two or more urinals, without use-detection equipment installed	7.5 litres per hour per urinal bowl or per 700 mm of urinal slab
Taps	Low pressure system (as defined in BS EN 200)	7.5 litres per minute per tap
	High pressure system (as defined in BS EN 200)	12 litres per minute per tap
Dishwashers	Domestic	14 litres per cycle
Washing machines	Domestic	55 litres per cycle

NOTE 1 Where no data is available on the performance of terminal fittings in the building, Table B.7 may be used as a guide. The defaults represent average performance of water fittings and are unlikely to reflect the actual performance of terminal fittings in the building.

NOTE 2 The following publications were referenced in the compilation of Table B.7:

- *Environment Agency, "The economics of water efficient products in the household" [19].*
- *BRE, "Micro component research into water conservation in domestic products" [20].*
- *Market transformation programme, "Baths – water efficiency performance tests" [2].*
- *Waterwise, "Dishwasher rankings" [21];*
- *Waterwise, "Washing machine rankings" [22];*
- *The Water Fittings Regulations [1].*

Table B.8 **Performance indicators for net water consumption in an office building** [A)]

Terminal fitting type	Performance indicator (total consumption - m^3 per annum) – occupied days			
	Baseline	Fair	Good	Excellent
WCs – male	182.16	151.80	121.44	91.08
WCs – female	728.64	607.20	485.76	364.32
Urinals – automatic flush control	151.80	122.05	30.36	16.39
Wash basin taps	493.05	369.78	185.20	123.26
Showers	142.69	102.01	81.36	61.33
Fixed usage – sanitary and drinking water	95.94	95.94	95.94	95.94
Kitchen taps (staff kitchenette)	216.77	180.95	90.47	90.47
Dishwashers (staff kitchenette)	41.29	31.57	29.15	24.29
Kitchen taps – pre-rinse nozzle (staff restaurant)	182.77	151.80	75.90	75.90
Dishwashers (staff restaurant)	213.73	163.34	151.19	125.69
Waste disposal units	15.18	15.18	15.18	15.18
Fixed usage (food preparation)	140.87	140.87	140.87	140.87
Fixed usage (kitchen cleaning)	400.14	400.14	400.14	400.14
Total NPCC (litres per person per day): consumption per day for occupied days (265 occupied days per annum)	49.49	41.71	31.34	26.76
Total NPCC (litres per person per day): average consumption per day for occupied and unoccupied days (365 days per year)	34.30	28.91	21.55	18.36
NPA (m^3 per annum)	3 005.03	2 532.63	1 902.96	1 624.87

[A)] Table B.8 is provided as an example for indicating performance in a range of building types. It is not for use in benchmarking the performance of a building at either the component or whole building level.

NOTE 1 The performance indicators are based on the performance indicators set out in Table B.6, using the following assumptions:

- *total floor area of 2 000 m^2;*
- *200 m^2 staff restaurant and no gym;*
- *253 days of occupation per annum for an office building;*
- *240 occupants taken from the defaults in Table B.1;*
- *use factors in Clause **7**; and*
- *zero gross savings from unwholesome water usage.*

NOTE 2 Urinals at the excellent level are waterless with the value accounting for the minimal level of water required per day for cleaning purposes.

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