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AIM OF CREDIT

To encourage and recognise the reduction in greenhouse gas emissions and resource use associated with the use of concrete.

CREDIT CRITERIA

Portland cement

Up to two points are available where the Portland cement content in all concrete used in the project has been reduced by replacing it with supplementary cementitious materials.

- One point is awarded where the Portland cement content is reduced by 30%, measured by mass across all concrete used in the project compared to the reference case; or
- Two points are awarded where the Portland cement content is reduced by 40%, measured by mass across all concrete used in the project compared to the reference case.

Aggregate and Water

One point is available where the mix water for all concrete used in the project contains at least 50% captured or reclaimed water (measured across all concrete mixes in the project), and one of the following criteria is met:

- At least 40% of coarse aggregate in the concrete is crushed slag aggregate or another alternative materials (measured by mass across all concrete mixes in the project), provided that use of such materials does not increase the use of Portland cement by over five kilograms per cubic meter of concrete;
- At least 25% of fine aggregate (sand) inputs in the concrete are manufactured sand or other alternative materials (measured by mass across all concrete mixes in the project), provided that use of such materials does not increase the use of Portland cement by over five kilograms per cubic meter of concrete.

If the cost of placed concrete (all costs) represents less than 1% of the project's contract value this credit is 'Not Applicable' and is excluded from the points available used to calculate the Materials Category Score.

COMPLIANCE REQUIREMENTS

Scope

This credit addresses all concrete used in the project including structural and non-structural uses. Concrete masonry is excluded.

Pre-existing concrete that is retained in a refurbished project, re-used concrete elements and recycled materials used in concrete masonry or other masonry, are addressed in Mat-2 'Building Re-use' and Mat-3 'Recycled and Re-used Products and materials' and are therefore not considered in this credit.

Documentation of Portland cement reduction

Calculating the Reference Case

A reference case is used as a basis for calculating the percentage reduction of Portland cement in the building.

The reference case represents the amount of Portland cement (in kilograms) that would

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have been used in the project if no supplementary cementitious materials were used.

The reference case should be established through the following steps (an example is provided in table 2):

- Establish the concrete mixes used in the project, their volume and strength grade.
- Based on table 1 calculate the total amount of Portland cement in each mix, in kilograms, assuming no supplementary cementitious materials are used.
- Add all totals of Portland cement in all mixes, this figure is the reference case for the project.

It is noted that not all concrete mixes used in a project may have exactly the concrete strength grades shown in Table 1. The project concrete designer or the supplier's concrete technologist will need to use figures in table 1 to calculate the amount of Portland cement in such mixes. This is to be done as a linear interpolation of the two closest performing concrete mix reference cases.

Concrete Strength grade (MPa following AS1379)	Portland cement content to be used in establishing the reference case (kg Portland cement/m^3 concrete)
20	280
25	310
32	360
40	440
50	550
65	550
80	610
100	660

Table 1: Portland cement content concrete strength grades as defined in AS1379 – The Specification and Supply of Concrete and standard cement contents for each strength grade.

At grades higher then 65MPa, the strength becomes determined by water content and other factors, not just cement content, hence the reference case for 50MPa and 65MPa is the same.

The reference case and the proposed design must have the same structural and functional requirements in the same location and season.

Portland Cement use Documentation Example

Table 2 shows a worked example of how the percentage of total Portland cement reduction shall be presented as a function of reference case and the actual case. Six different mixes are used in the example and the reference case Portland cement content and the actual Portland cement content is calculated for each mix. The total Portland cement content in the reference case and the actual case are then compared to establish the overall percentage reduction in Portland cement, in this case 38.3%.

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Mix Label	MPa (following AS1379)	Volume (m^3)	Reference Case Portland Cement Content (kg/m3)	Total Portland Cement Content Under the Reference Case	Actual Portland Cement Content (kg/m^3)	Actual Total Portland Cement Content
Mix 1	20	300	280	84000	128	38400
Mix 2	32	800	360	288000	166	132800
Mix 3	32	4400	360	1584000	238	1047200
Mix 4	40	290	440	127600	247	71630
Mix 5	50	90	550	49500	295	26550
Mix 6	65	100	550	55000	333	33300
Overall Total Portland Cement (kg)				**2188100**		1349880
Overall percentage of replacement				**1-(1359480/2188100)x100)=38.3%**		
Portland cement content in this example was reduced by 38.3% and is awarded with one point						

Table 2: An example of how the percentage of total Portland cement reduction shall be presented as a function of reference case and the actual case

Captured or Reclaimed Water

Captured or reclaimed water is defined as rainwater captured on either the concrete supplier's manufacturing site, or another site, or recycled/recovered from a previous use such as blackwater or greywater from any locations.

Alternative Coarse and Fine Aggregate

Acceptable types of alternative coarse and fine aggregate are listed in Cement Concrete and Aggregate Australia publications Use of Recycled Aggregates in Construction and Guide to the Specification and Use of Manufactured Sand in Concrete.

Water and Aggregate Schedule Example

Table 3 shows an example of how use of alternative aggregate and captured water are documented. Values to be provided from the concrete supplier and verified on the basis of supplier batching or production records

The purpose of this example only includes documentation of fine aggregate, documentation of coarse aggregate should be performed in a similar manner.

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		Water				Fine Aggregate			
Mix Label	**Mix Volume (m^3)**	**Total (L /m^3)**	**Total Water Content**	**Reclaimed or Captured Component (L/m^3)**	**Total Reclaimed or Captured Water**	**Total (kg/m^3)**	**Total Fine Aggregate in Mix**	**Alternative Fine Aggregate Component (kg/m^3)**	**Total Alternative Fine Aggregate**
Mix 1	300	142	42600	142	42600	867	260100	335	100500
Mix 2	800	141	112800	141	112800	802	641600	270	216000
Mix 3	4400	138	607200	70	308000	834	3669600	245	1078000
Mix 4	290	146	42340	70	20300	670	194300	90	26100
Mix 5	90	159	14310	0	0	553	49770	0	0
Mix 6	100	125	42600	0	42600	677	260100	0	100500
Totals		**-**	**819250**	**-**	**483700**	**-**	**4815370**	**-**	**1420600**
Overall percentage of replacement		**(483700/819250)x100= 59.04%**				**(1420600/4815370)x100= 29.05%**			

Use of captured and reclaimed water in this example exceeds 50%, use of alternative fine aggregate in this example exceeds 25%, as such one point may be awarded in this example

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DOCUMENTATION GUIDELINES - DESIGN

Submit all the evidence and ensure it readily confirms compliance.

☐ Short report

Where Portland cement reduction is claimed

☐ Structural engineer's report

☐ Extract(s) from the specification(s)

Where the use of reclaimed or captured water and alternative aggregate is claimed

☐ Structural engineer's report

☐ Extract(s) from the specification(s)

Where the credit is not applicable

☐ Confirmation from the Quantity Surveyor

☐ Extract(s) from the contract

OR

☐ Confirmation from the Architect, Quantity Surveyor or Head Contractor

Short report summarising the credit criteria that are claimed.

Where Portland cement reduction is claimed

- **Structural engineer's report** include a summary calculation of the Portland cement content in the project based on the reference case and the actual case as well as the percentage reduction of Portland cement. Table 2 shall be used when documenting Portland cement use and relevant percentages.
- **Extract(s) from the specification(s)** that require Portland cement reductions across all concrete mixes in the project and requiring the supplier to establish the reduction of Portland cement use against the reference case.

Where the use of reclaimed or captured water and alternative aggregate is claimed

- **Structural engineer report** identifying all water or coarse or fine aggregate uses in the project and demonstrating how the Credit Criteria is met, Table 3 shall be used when documenting water and aggregate use and relevant percentages.
- **Extract(s) from the specification(s)** including requirements for substitution of a percentage of water and aggregate and requiring that the use of alternative aggregate does not increase the use of Portland cement by more than 5kg per cubic metre.

Where the credit is not applicable

- **Confirmation from the quantity surveyor** comparing the cost of concrete specified in the project against the project's total contract value;
- **Extract(s) from the contract** that includes the project's total value.

OR

- **Confirmation from the architect, quantity surveyor or head contractor** that no new concrete is specified in the project.

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DOCUMENTATION GUIDELINES - AS BUILT

Submit all the evidence and ensure it readily confirms compliance.

☐ Short report

Where Portland cement reduction is claimed

☐ Structural engineer's report

Where the use of Recycled, captured or reclaimed water and alternative aggregate is claimed

☐ Structural engineer's report

For all criteria claimed

☐ Suppliers batching records

Where the credit is not applicable

☐ Confirmation from the Quantity Surveyor

☐ Extract(s) from the contract

OR

☐ Confirmation from the Architect or Head Contractor

Short report summarising the credit criteria that are claimed

Where Portland cement reduction is claimed

- **Structural engineer's report** include a summary calculation of the Portland cement content in the project based on the reference case and the actual case as well as showing the percentage reduction of Portland cement. Table 2 shall be used when documenting Portland cement use and relevant percentages.

Where the use of reclaimed or captured water and alternative aggregate is claimed

- **Structural engineer report** identifying all water or coarse or fine aggregate uses in the project and demonstrating how the Credit Criteria is met, Table 3 shall be used when documenting water and aggregate use and relevant percentages.

For all credit criteria claimed

- **Suppliers batching records** for concrete delivered to site clearly highlighting type, quantities and strength of all concrete and detailing quantities and types of Portland cement, water, recycled, captured and reclaimed water, virgin aggregate and alternative aggregate (fine or coarse). Quantities must correlate with credit criteria being claimed.

Where the credit is not applicable

- **Confirmation from the quantity surveyor** comparing the cost of concrete specified in the project against the project's total contract value;
- **Extract(s) from the contract** that includes the project's total value.

OR

- **Confirmation from the architect, quantity surveyor or head contractor** that no new concrete is specified in the project.

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ADDITIONAL GUIDANCE

Portland Cement

Portland cement is the combined Portland cement clinker and calcium gypsum which is used in the manufacture/production of various cement types. Portland cement is defined in Australian Standard AS3972 – 2010 General purpose and blended cements section 3.2.

Supplementary Cementitious Materials

Supplementary cementitious materials include flyash, ground granulated blast furnace slag, and amorphous silica They are defined in Australian Standard 3582 - Supplementary cementitious materials for use with Portland and blended cements.

Mineral additions include flyash, ground granulated blast furnace slag or limestone and are defined in AS 3972-2010 General purpose and blended cements.

Batching Records

Batching or production records should be retained following project completion. This way projects applying for an as-built rating are assured the necessary documentation will be available when needed; suppliers may not keep batching or production record for more than one year from delivery of concrete.

BACKGROUND, REFERENCES & FURTHER INFORMATION

Cement Concrete & Aggregates Australia (CCAA) 2012, Concrete Credit User Guide http://www.concrete.net.au/publications/pdf/GuideMAT4User.pdf

Cement Concrete & Aggregates Australia (CCAA), 2008, *Use of Recycled Aggregates in Construction*, http://www.concrete.net.au/publications/pdf/RecycledAggregates.pdf.

Cement Concrete & Aggregates Australia (CCAA), 2008, *Guide to the Specification and Use of Manufactured Sand in Concrete*, http://www.concrete.net.au/publications/pdf/GuideManSand.pdf

Refer to the Background and Outcomes of the *Concrete Credit Review* document available on the GBCA website for further background and references http://www.gbca.org.au