

**0000 OYSTER SHELL CONSTRUCTION****1 GENERAL****1.1 GENERAL****General**

This worksection refers to the selection of oyster shells for their use in the project in the form of whole oyster shells, oyster shell aggregate, oyster shell gravel or it's processing from shell to lime for applications in mortar or render. Use this work section for the selection of oyster shells, tolerances and ratio allowances and is to be read in conjunction with other worksections for specific requirements of materials to be integrated with oyster shells.

**1.2 CROSS REFERENCE****Specification**

The following work sections are to be read in conjunction with this section:

- *Landscaping* for gabion walls and oyster shell gravel applications
- *Service trenching* for oyster shell free draining backfill
- *Concrete* for oyster shell aggregate integration to concrete applications.
- *Brick and block construction* for blockwork and mortar integration with shell aggregate and shell lime
- *Plastering and rendering* for the integration of shell aggregate and shell lime in mortar and plaster applications
- *Roofing* for waterproofing and shell tiles
- *Joinery* for integration of shell-based bench tops with joinery
- *Tiling* for shell integrated tiles and mortar/grout

**Drawings**

The following work sections are to be read in conjunction with the following drawings:

- Point Lonsdale Oyster Pavillion, CD/01-CD/12
- *Network Engineer's* Structural Engineering Drawings, project number 24404, S01-S26

In the event of a contradiction, the details outlined in this work section take precedence.

**1.3 DEFINITIONS**

- *Oyster*: the common name of different families of saltwater molluscs.
- *Shell or sea shell*: the toughened protective outer layer of a mollusc.
- *Left shell*: the cupped shell of an oyster, in which typically flesh is served (refer category 2).
- *Right shell*: the flat shell of an oyster, which is typically discarded (refer category 2).

- *Quicklime*: Calcium oxide (CaO), a chemical derivative of calcium hydroxide and a volatile compound that reacts with water to produce *lime putty* or *hydrated lime powder*.
- *Hydrated lime*: *quicklime* that has undergone *slaking* to create a chemically stable product.
- *Slaking or lime slaking*: the process of converting *quicklime* into *hydrated lime*.
- *Lime putty*: a form of *slaked quicklime* that resembles a putty and stored underwater and is no longer volatile.
- *Hydrated lime powder*: a form of *slaked quicklime* that is in powder form and is no longer volatile.
- *Shell lime*: either hydrated lime powder or lime putty which has been manufactured from oyster shells
- *Curing*: the process of laying shells in the elements to remove diseases and breakdown leftover flesh.
- *Shell aggregate*: aggregate which consists of oyster shells.

#### 1.4 SIGN OFF

##### Shells selection

Confirm colour variation of oyster shells with architect for sign off prior to crushing or use, except when any grade is nominated as acceptable.

#### 1.5 SUBMISSION

##### Samples

Submit samples to the architect prior to the manufacture of any material including but not limited to: bricks, tiles & concrete.

## 2 PRODUCTS ---

### 2.1 OYSTER SHELLS

#### Storage and handling

Curing: generally minimum of three months prior to use.

Gabion wall curing: when used on shoreline minimum of six months prior to use. When used as a structure for curing of shells, no minimum curing requirement

Handling: ensure shells are completely dry and moisture free prior to use.

### 2.2 GRADING OF OYSTER SHELLS

#### Category 01: Species

Species selection to be considerate of locally sourced oysters and shells. Oysters are to be sourced sustainable from recycling plants, landfill or direct from restaurants. Oyster shells are not to be

removed from coastlines or oceans. Generally, the following shall apply for oyster shell selection unless otherwise approved.

SPECIES	TAS	VIC	SA	ACT	NSW	QLD	WA	NT
<b>Magallana gigas</b> <i>Pacific Oyster</i>	X	X	X	X	X	SOUTH ONLY	SOUTH ONLY	
<b>Saccostrea glomerata</b> <i>Sydney/Albany Rock Oyster</i>		X		X	X	SOUTH ONLY	SOUTH ONLY	
<b>Ostrea angasi</b> <i>Angasi Oyster</i>	X	X	X					
<b>Saccostrea cucullate</b> <i>Hooded Oyster</i>								
<b>Pinctada maxima</b> <i>South Sea Pearl Oyster</i>							NORTH ONLY	X
<b>Pinctada fucata</b> <i>Akoya Pearl Oyster</i>					NORTH ONLY	SOUTH ONLY	X	X
<b>Pinctada margaritifera</b> <i>Black Lip Pearl Oyster</i>						NORTH ONLY	NORTH ONLY	X

### Category 02: Shell

To identify which shell should be used in each application, the following references shall be applied.

NAME	DESCRIPTION	EXEMPLAR
LSE (left shell exterior)	<ul style="list-style-type: none"> <li>- Cupped oyster shell in which typically the flesh is served</li> <li>- Coloured exterior facing externally</li> </ul>	
RSE (right shell exterior)	<ul style="list-style-type: none"> <li>- Flat oyster shell which is typically discarded</li> <li>- Coloured exterior facing externally</li> </ul>	

LSI (left shell interior)	<ul style="list-style-type: none"> <li>- Cupped oyster shell in which typically the flesh is served</li> <li>- White interior facing externally</li> </ul>	
RSI (right shell interior)	<ul style="list-style-type: none"> <li>- Flat oyster shell which is typically discarded</li> <li>- White interior facing externally</li> </ul>	
RSX or LSX	<ul style="list-style-type: none"> <li>- Right shell or left shell as notated without a preference of external face</li> </ul>	

**Category 03: Colour**

Adhere to the following oyster shell colour grading system in all parts of this worksection.

PHOTO	COLOUR GRADE	IDENTIFIABLE BY:	SPECIES PRESENT IN
	C1	Majority cream, minimal to no purple variation	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>South Sea Pearl Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	S1	Majority cream, thin purple stripes visible	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	S2	Striped with even distribution of cream and purple	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	S3	Majority purple, cream stripes visible	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>

	S4	Majority purple, cream pin stripes visible	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	B1	Blotched colours, approximately even distribution of purple and white	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	B2	Blotched, larger variation of purple colouring	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	B3	Majority purple, minimal cream blotches	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	P1	Majority purple, minimal to no cream blotches.	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	G1	Any formation of greening on the surface of the shell, regardless of under shell colour.	<ul style="list-style-type: none"> <li>- <i>Pacific Oyster</i></li> <li>- <i>Sydney/Albany Rock Oyster</i></li> <li>- <i>Akoya Pearl Oyster</i></li> </ul>
	T1	Tan, striped, sometimes a sludgy green. This is largely reserved for <i>ostrea angasi</i> which has minimal colour variation	<ul style="list-style-type: none"> <li>- <i>Angasi Oyster</i></li> </ul>
	L1	Majority black in colour with high presence of white dotted stripes. Base of shell may be lighter in colour.	<ul style="list-style-type: none"> <li>- <i>Black Lip Pearl Oyster</i></li> </ul>

	L2	Majority black in colour, presence of white dotted stripes	- Black Lip Pearl Oyster
	L3	Largely black in colour with minimal to no white dotted stripes	- Black Lip Pearl Oyster

**Category 04: Aggregate Sizing**

Fragmenting: Crush and sift to achieve desired sizing.

Sizing: refer to the fragment sizing table for aggregate classifications:

Naming convention	Shell fragment sizing	Photo of desired effect
Superfine shell	0.5-1cm fragments	
Fine shell	1-2cm fragments	
Coarse shell	2-4cm fragments	
Super coarse shell	4cm+ fragments	

Whole shell	Uncrushed, naturally occurring shells	
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### Selections

Refer to schedules in this worksection.

### 2.3 QUICKLIME

#### Manufacture

Calcification: manufacture offsite. Heat shells to 900°C in an appropriate lime kiln until quicklime is produced.

Testing: shells should appear grey white and crumble easily. Separate 1 tablespoon of suspected quicklime and allow to cool. Add droplets of water. If exothermic reaction occurs, quicklime has been produced.

#### Storage and handling

Handling: allow to cool for a minimum of 8 hours before slaking. Wear appropriate PPE including a respirator. Avoid contact with eyes and skin.

Storage: quicklime is only to be stored for a maximum of 48 hours before slaking. Store in an airtight contained separated from water and moisture. Quicklime is not to be transferred to or stored on construction site under any circumstances.

### 2.4 LIME PUTTY

#### Manufacture

Slaking: allow quicklime to completely cool prior to manufacturing lime putty. Gradually add 2 parts water to 1 part quicklime and allow to react completely and cool. Strain before storing.

Storage: store in an airtight container under 5cm of water.

Maturing: allow to mature for minimum 24 hours prior to application.

### 2.5 HYDRATED LIME POWDER

#### Manufacture

Slaking: allow quicklime to completely cool prior to manufacturing hydrated lime powder. Gradually add 1 part water to 1 part quicklime and allow to react completely and cool.

Storage: spread and allow to dry completely into powder before storing. Sift before storing. Store in an airtight container away from water and moisture.

### 3 EXECUTION

#### 3.1 AGGREGATE

##### Aggregate mixing

General: measure volume accurately to the documented proportions. Adhere to concrete curing requirements to manufacturers specifications. Machine mix until thoroughly integrated in concrete.

##### Storage and handling

General: store alternate fragment denominations separately. Store superfine and fine shell grade aggregates away from moisture and water. Allow aggregate to thoroughly dry prior to use.

#### 3.2 MORTAR

##### Selection

Refer to schedule for lime putty vs hydrated lime powder use in materials. Refer to schedule for oyster shell grading selections for aggregate purposes.

##### Mortar mixing

General: Measure volumes accurately to the documented proportions as per schedules of this worksection. Machine mix for at least six minutes. If the initial set of the cement has taken place, discard the mortar. Do not retemper.

##### General

Refer to worksection *brick and block construction & rendering and plastering* for typical material requirements.

#### 3.3 MASONRY

##### Selection

Refer to schedule for lime putty or hydrated lime powder use in materials. Refer to schedule for oyster shell grading selections for aggregate purposes.

##### Masonry units

Method: Mix sand, aggregate, shell lime and water to specification outlined in schedule.

### 4 SELECTIONS

#### 4.1 SCHEDULES

##### Concrete

TAG	CATEGORY 01 SPECIES	CATEGORY 02 SHELL	CATEGORY 03 COLOUR	AGGREGATE	RATIO	NOTES
C01: CONCRETE 01 - VAULT	Magallana gigas	LSX & RSX	Strict: G1	1:1:3:3 superfine,	1:3:5 cement,	Refer to engineering drawings for

	<p><i>(Pacific Oyster)</i></p> <p>Saccostrea glomerata</p> <p><i>(Sydney Rock Oyster)</i></p>			fine, coarse, super coarse	sand, aggregate	<p>full concrete requirements</p> <p>Read in conjunction with 310 Concrete for general concreting &amp; form ply requirements</p>
<b>C02: CONCRETE 02 - VAULT</b>	<p>Magallana gigas</p> <p><i>(Pacific Oyster)</i></p> <p>Saccostrea glomerata</p> <p><i>(Sydney Rock Oyster)</i></p>	LSX & RSX	Strict: B1, B2, B3, P1	1:1:3:3 superfine, fine, coarse, super coarse	1:3:5 cement, sand, aggregate	<p>Refer to engineering drawings for full concrete requirements</p> <p>Read in conjunction with 310 Concrete for general concreting &amp; form ply requirements</p>
<b>C03: CONCRETE 03 - SLAB</b>	<p>Magallana gigas</p> <p><i>(Pacific Oyster)</i></p> <p>Saccostrea glomerata</p> <p><i>(Sydney Rock Oyster)</i></p>	LSX & RSX	No preference	1:1:3:3 superfine, fine, coarse, super coarse	1:3:5 cement, sand, aggregate	Refer to engineering drawings for full concrete requirements
<b>C04: CONCRETE 04 – BENCHES &amp; SEATS</b>	<p>Magallana gigas</p> <p><i>(Pacific Oyster)</i></p> <p>Saccostrea glomerata</p> <p><i>(Sydney Rock Oyster)</i></p>	LSX	No preference	1:1:3:3 superfine, fine, coarse, super coarse	1:3:5 cement, sand, aggregate	Refer to engineering drawings for full concrete requirements

## Tiles

TAG	CATEGORY 01 SPECIES	CATEGORY 02 SHELL	CATEGORY 03 COLOUR	AGGREGATE	RATIO	NOTES
<b>T01: TILE 01: VAULT</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata  <i>(Sydney Rock Oyster)</i>	LSX	Strict: C1, G1, approximately 1:4	Fine only	1:3:3:0.5 white cement, sand, aggregate, green pigment	Refer to engineering drawings for full concrete requirements. Submit samples prior to manufacturing  300X300 tile, to be used in conjunction with M01
<b>T02: TILE 02: VAULT</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata  <i>(Sydney Rock Oyster)</i>	LSX	Strict: C1, P1, approximately 1:1	Fine only	1:3:3:0.5 white cement, sand, aggregate, purple pigment	Refer to engineering drawings for full concrete requirements. Submit samples prior to manufacturing  300X300 tile, to be used in conjunction with M01
<b>T03: TILE 03: SPLASH- BACK</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata  <i>(Sydney Rock Oyster)</i>	LSI	Strict: C1, G1, approximately 1:4	Fine only	1:3:3:0.5 white cement, sand, aggregate, green pigment	Refer to engineering drawings for full concrete requirements. Submit samples prior to manufacturing  100X100 tile, to be used in

						conjunction with M01
<b>T04: PAVER</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata  <i>(Sydney Rock Oyster)</i>	LSI	Strict: C1, P1, approximately 1:1	Fine only	1:3:3:0.5 white cement, sand, aggregate, purple pigment	Refer to engineering drawings for full concrete requirements. Submit samples prior to manufacturing  100X100 tile, to be used in conjunction with M01

**LANDSCAPING**

<b>TAG</b>	<b>CATEGORY 01 SPECIES</b>	<b>CATEGORY 02 SHELL</b>	<b>CATEGORY 03 COLOUR</b>	<b>AGGREGATE</b>	<b>RATIO</b>	<b>NOTES</b>
<b>G01: GRAVEL 01: AG DRAIN FREE- DRAINING BACKFILL</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata  <i>(Sydney Rock Oyster)</i>  Ostrea angasi <i>Angasi Oyster</i>	All	All	Strict: coarse, super coarse & whole shell	N/A	Large aggregate only, sort to remove fine & superfine aggregates
<b>G02: GRAVEL 02: GENERAL PATH</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata	RSX	All	Fine & coarse	N/A	

	(Sydney Rock Oyster)					
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## GENERAL

TAG	CATEGORY 01 SPECIES	CATEGORY 02 SHELL	CATEGORY 03 COLOUR	AGGREGATE	RATIO	NOTES
<b>DPnw – OYSTER SHELL RAIN CHAIN</b>	Magallana gigas <i>(Pacific Oyster)</i>	LSE	All – no two colour grades to be used in immediate succession	Whole shell	N/A	Select appropriate aluminium
<b>P01 – PERGOLA</b>	Magallana gigas <i>(Pacific Oyster)</i> Saccostrea glomerata <i>(Sydney Rock Oyster)</i> Ostrea angasi <i>Angasi Oyster</i>	RSE – interior to face ground	All	Whole shell	N/A	

## LIME SELECTIONS

ITEM	LIME SELECTION	CATEGORY 01 SPECIES	CATEGORY 02 SHELL	CATEGORY 03 COLOUR	RATIO	NOTES
<b>Bricks, typically</b>	Lime putty	Magallana gigas <i>(Pacific Oyster)</i> Saccostrea glomerata <i>(Sydney Rock Oyster)</i>	All	Superfine & fine	1 part lime, 3 parts aggregate, 1 part sand, water	
<b>Mortar for</b>	Hydrated lime powder	Magallana gigas	All	Superfine & fine	1 part lime, 3 parts aggregate	

<b>brickwork bonds</b>		( <i>Pacific Oyster</i> )  Saccostrea glomerata  ( <i>Sydney Rock Oyster</i> )			and sand mix	
<b>Render for rendered walls</b>	Hydrated lime powder	Magallana gigas  ( <i>Pacific Oyster</i> )  Saccostrea glomerata  ( <i>Sydney Rock Oyster</i> )	All	Superfine, fine & coarse, 3:3:1	1 part lime, 3 parts aggregate and sand mix	

## 5 EXAMPLES

### 5.1 REFERENCES

MATERIAL	CATEGORY 01 SPECIES	CATEGORY 02 SHELL	CATEGORY 03 COLOUR	AGGREGATE	RATIO	EXAMPLE
<b>Concrete</b>	Magallana gigas  ( <i>Pacific Oyster</i> )	N/A	All	Superfine, fine, coarse, supercoarse	1:3:5 cement, sand, aggregate	
<b>Tile</b>	Magallana gigas  ( <i>Pacific Oyster</i> )  Saccostrea glomerata  ( <i>Sydney Rock Oyster</i> )	N/A	B1, B2, B3, P1	Fine, coarse	1:3:3 cement, sand, aggregate	

	Ostrea angasi <i>Angasi Oyster</i>					
<b>Rain chain</b>	Magallana gigas <i>(Pacific Oyster)</i>  Saccostrea glomerata <i>(Sydney Rock Oyster)</i>	LSE	Any: no two colour grades to be used in immediate succession	Whole shell	N/A	