

Alternatives for river sand

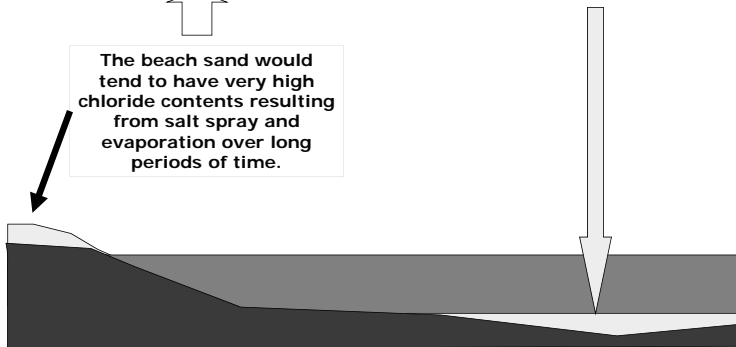
Prof. SMA Nanayakkara
University of Moratuwa

Alternatives for river sand

- Offshore sand →
- Crushed rock fine (Quarry dust) / "Manufactured sand"

Beach Sand \neq Offshore sand

The beach sand would tend to have very high chloride contents resulting from salt spray and evaporation over long periods of time.



Use of Offshore sand in Other countries

- Sea dredged sand and gravel contribute 24% (20 m.tons/year) of total aggregate consumption in U.K.
- The use of such aggregate in concrete has not caused any major durability problems in U.K. during the past 60 years of its use.

Major civil Engineering projects in UK where marine aggregates have been used



Thames Barrier

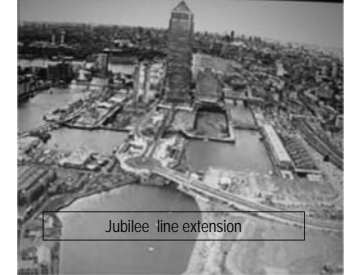
Millennium Dome



5



Cross channel rail terminal of Waterloo



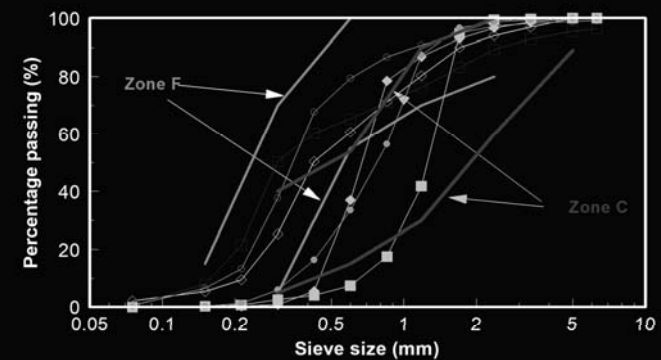
Jubilee line extension

6

Problems with Offshore Sand

- Grading (Particle size distribution) - Variable
- Shells – Workability?, Permeability?
- Salt contamination – Corrosion r/f, Efflorescence

7



Particle size distribution of offshore sand

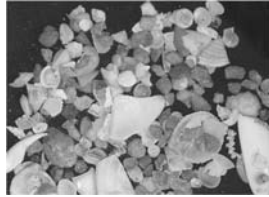
8

Shell content in Offshore sand

Shells > 5mm - 0.6% ~ 5.3%
< 5mm - 6.5% ~ 39.0%



Can be used to produce Lime



BS 882 Limits for shell content



Fine aggregate - No limit
10-5mm aggregate - 20% by wt.
>10mm aggregate - 8%

SLS 1397:2010: specifications for fine aggregate for Concrete & mortar



Shell content (< 4 mm) - less than 15 %

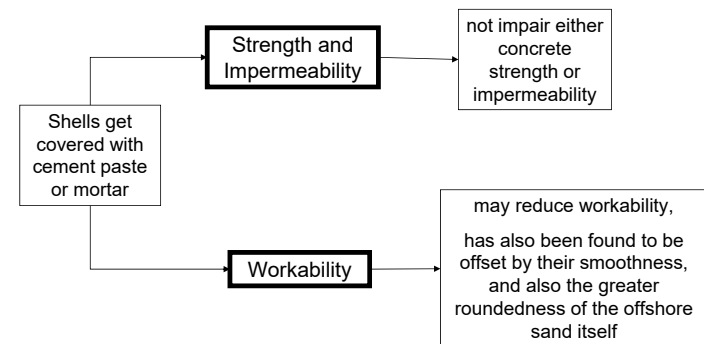


Particle size : 1.4 mm – 2.8 mm

Offshore sand

River sand

Effects of Shells present in offshore sand



Chloride content in offshore sand

Saturated surface moist condition	- 0.28 %
Saturated drained condition	- 0.08 %
Washed with fresh water/rain water	→ %

Type of concrete	Mandatory limit for concrete to comply with BS5328:1997-Table 6.4 (wt % of cement)	Guidance limit for aggregate* in BS 882:1992 Table 8 Appendix C (wt % of aggregate)
Prestressed concrete	0.1	0.01
Concrete with SRPC	0.2	0.03
Concrete with OPC and blended cements	0.4	0.05

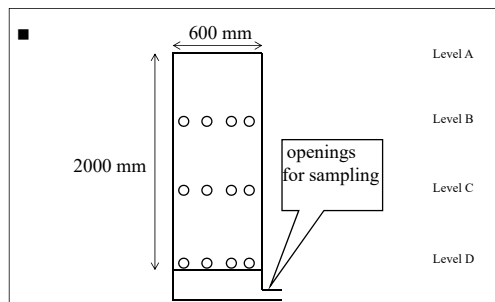
* The combined aggregates, i.e., coarse and fine aggregate combined in the proportion to be used in concrete.

Grade	Mix proportion (kg/m ³)			Maximum total chloride content in concrete expressed as a % of Cl ⁻ by mass of sand		
	C	S	G	Prestressed concrete	Concrete with SRPC	Concrete with OPC
20	350	788	962	-	0.066	0.155
25	390	765	935	-	0.076	0.178
30	430	743	908	0.029	0.087	0.202

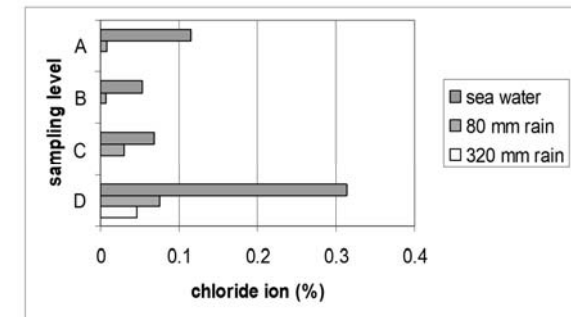


SLS1397:2010 : Cl⁻ limit for fine aggregate – 0.01%

Testing of sand column: drainage, rain-effect



Testing of sand column: results



Recommendation : Sieving and washing with fresh water

Checking/monitoring Chloride content in offshore sand stock pile



Chloride sensor



Chloride strips

17

Sulphate content

- The sulphate content of the offshore sand samples tested is about 0.025% which is very low .
- No sulphate limits are specified in BS 882 for natural aggregates like sea sand.
- According to the BS specification ,BS 8599-2002 (specifications for constituent materials and concrete), the sulphate limit is given only for light weight aggregate which shall be not more than 1%.

Prof SMA Nanayakkara
University of Moratuwa

18

SLS 1397:2010: specifications for fine aggregate for Concrete & mortar

4.3.2.1 Acid-soluble sulfate

The acid-soluble sulfate content of the aggregates shall be less than 0.2 per cent when determined in accordance with **BS EN 1744-1**.

4.3.2.2 Total sulfur

The total sulfur content of the aggregate, determined in accordance with **BS EN 1744-1**, shall not exceed 1 per cent by mass for natural aggregates.

Prof SMA Nanayakkara

University of Moratuwa

19

Concluding remarks

Offshore sand is a suitable alternative for river sand in concrete and masonry construction

Offshore sand should be processed by sieving and washing to remove large shells and chlorides

Since the offshore sand particles are rounded and smooth, workability of the concrete improves.

Prof SMA Nanayakkara

University of Moratuwa

20