Aggregates and stone – the Irish situation

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Uses of natural stone

1. Concrete aggregate – fine & coarse
2. Structural Concrete
3. Road sub-base, base & top-dressing
4. Rock-fill – embankments &c.
5. Gabions –retaining walls, revetments
6. Dimension stone, armour stone
7. Specialist sands – filter beds, mortars etc.
8. Rail ballast

Sources of coarse aggregates

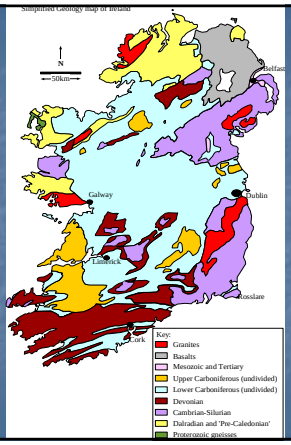
- Bedrock quarries
- Crushed gravels
- (Recycled concrete)

Coarse aggregate

- Bedrock –
  - Petrographically simple
  - Uniform properties – easily characterised
  - Easily graded – crushing, screening & blending
  - Irish examples all well known
- Crushed gravels
  - Complex composition
  - Less easily characterised
  - Much like associated sands in composition

Bedrock quarries in Ireland

- Carboniferous limestone
- Lower Palaeozoic graywacke
- Lower Palaeozoic volcanic rock
- Old Red Sandstone
- Antrim basalt
- Namurian sandstone



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	AIV	ACV	AAV	10% Fines	PSV	% Water abs.	MgSO4	LAAV
Carboniferous Limestone								
Mean	19.1	22.5	9.8	190	42.8	0.69	97.0	26.25
S. Dev	2.91	2.25	2.28	26	3.68	0.34	0.50	3.30
Range	14 -26	18-26	6 - 15.7	155-290	34-47	0.3-1.6	95-99	22-30
Lower Palaeozoic volcanic rocks								
Mean	11.9	13.5	4.65	315	57	0.9	98	
S. Dev	2.28	1.76	1.3	43	4.1	0.2		
Range	8-14	12-17	3.1-5.7	270-380	50-63	0.2-1.1	98-99	
Lower Palaeozoic greywackes								
Mean	10.0	10.7	6.73	375	64	0.5	98	
S. Dev	0.9	1.0	1.6	38	2.8			
Range	9-12	10-11	4.8-9.4	320-400	62-68			

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Deleterious substances in Irish bedrock aggregates

- Clay – limestones especially
- Pyrites
- Chert
- Matrix of graywackes → Alkali Aggregate Reaction
- Matrix of argillaceous limestones (dark, shaly limestones)

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Alkali Aggregate Reaction

- Irish Carboniferous chert – unreactive
- - thermally annealed-
- - high degree of crystallinity
- - not microporous
- - some pass, some fail Accelerated Mortar Bar Test
- Irish graywackes & argillaceous Carboniferous limestones
- - fail Accelerated Mortar Bar Test

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Fine aggregates

- 1. Glaciofluvial sands (well graded)
- 2. Marine dredged sands (poorly graded)
- 3. Crushed sandstones (poorly graded)
- 4. Crushed-rock fines (gap-graded)

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Repeat assays from different parts of same sand deposit

(Typical Irish Midlands sand)

	2005/9	2005/11
Limestone	78.81	83.79
Quartz	4.85	3.03
Chert	13.59	10.38
Sandstone /siltstone	2.24	2.02
Dolomite	0.52	0.77
Totals	100.01	99.99

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West Wicklow sands 1

- Limestone 41.9 35.1 41.9 54.1 44.3
- Chert 28.0 32.8 28.0 25.6 25.2
- Quartz 18.9 17.5 18.9 13.0 10.7
- Sandstone 2.7 4.3 2.7 2.7 1.3
- Feldspar &c 2.6 1.0 2.5 2.1 0.8
- Wackes &c 6.0 8.7 6.0 2.0 16.5

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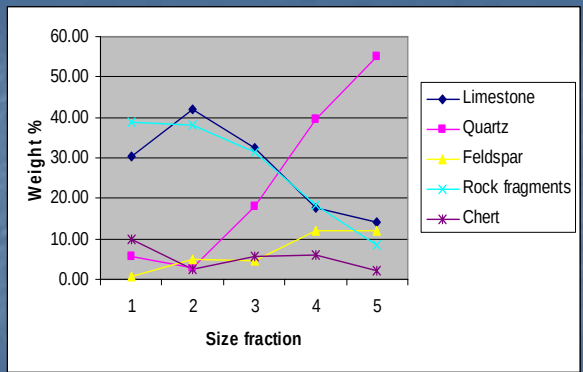

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Glaciofluvial sands

- Regional variation in composition
- Reflection of bedrock within 10-20 kilometres upstream

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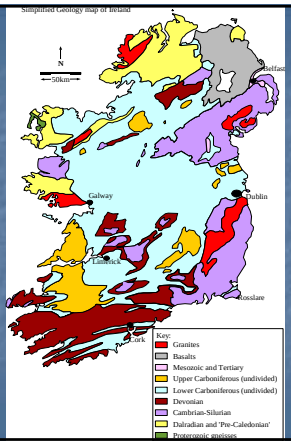

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West Wicklow sands 1
(Blessington area)

- Limestone 41.9 35.1 41.9 54.1 44.3
- Chert 28.0 32.8 28.0 25.6 25.2
- Quartz 18.9 17.5 18.9 13.0 10.7
- Sandstone 2.7 4.3 2.7 2.7 1.3
- Feldspar &c 2.6 1.0 2.5 2.1 0.8
- Wackes &c 6.0 8.7 6.0 2.0 16.5

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West Wicklow sands 2
(Baltinglass area)

- Limestone 43.0 40.7 44.6 16.9 4.7
- Chert 18.0 36.2 41.1 33.6 10.6
- Quartz 30.5 10.0 8.8 19.3 49.0
- Sandstone 1.5 9.1 1.7 2.5 0.6
- Feldspar &c 9.9 30.8
- Wackes &c 1.9 16.9 16.5
- Volcanics 7.0 4.0 1.9 0.6

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Dredged sands

- Poorly graded – tidal reworked glacial deposits
- Complex mineralogy. Shell content, Cl^-
- Environmental problems – EIS costs
- – ecological damage – fishing etc.
- - shoreline erosion
- - deep water, high cost

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Crushed rock fines

- Primary crushing - grading poor, clay
- Re-crushing of clean stone
- Poor shape – anisotropic – crushing technique

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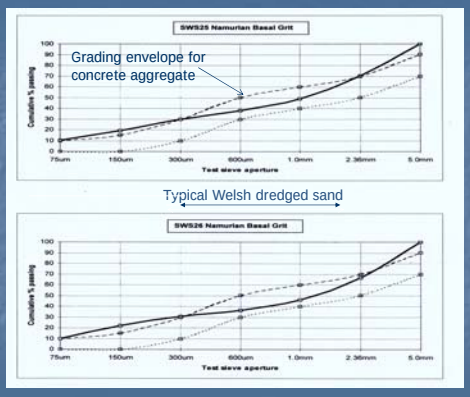

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Crushed sandstones

- Friable – easily reduced to sand again.
- Very poorly graded.
- Rare in Ireland – mainly Mesozoic to Tertiary in age.

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Conclusions

- Ireland well endowed with stone reserves
- Few deleterious substances
- No problems of Alkali Aggregate Reaction
- Dredged sand/crushed rock sand to increase
- Greater use of borrow pits, cut & fill
- Greater use of dimension stone?

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References

- Strogen, P. 1993. Study of cherts in fine and coarse aggregates in Ireland. *Concrete*, 27, No.2, 26-29.
- McNally, C., Richardson, M. G., Carr, A. & Strogen ,P. 2004. Domain size as a parameter for studying the potential alkali-silica reactivity of chert-bearing aggregates. *Magazine of Concrete Research*, 56, No.4, 201-209.

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