Resistance to fragmentation of Recycled Concrete Aggregate

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Outline

• Introduction
• Los Angeles test
• Materials
• Experimental plan
• Results
• Analysis
• Conclusion
INTRODUCTION
Introduction

- Are those test procedures relevant for recycled materials?
- Case of the resistance to fragmentation (Los Angeles test)
Los Angeles test (NF EN 1097-2)

Sample reconstitution

- 10/14 mm fraction with 60-70% of 10/12.5 and 30-40% of 12.5/14
- 5000 g of test specimen

Sample is rotated in a drum

- Dry specimen
- With 11 spherical steel ball (45-49 mm diameter)
- 31-33 rotation per min
- 500 revolutions

Determination of fine production

- 1.6 mm wet sieving

Calculation of LA coefficient

\[ LA = \frac{5000 - m}{m} \]
- With m dry mass retained on the 1.6 mm sieve
- High LA, low resistance to fragmentation
MATERIALS
Materials

- 4/10 and 10/20 Recycled Concrete Aggregate
  - in situ produced near Paris
- sieved in order to get 4 size fractions
  - 4/6.3 ; 6.3/10 ; 10/14 ; 14/20 mm
- 10/14 mm Natural Aggregate (NA) (gneiss)
  - reference
EXPERIMENTAL PLAN
Experimental plan – 1st step

- RCA 4/6.3, 6.3/10, 10/14, 14/20, NA 10/14
- Drum rotations
  25, 50, 100, 150, 200, 300, 500, 750, 1000, 1500, 2000, 3000, 5000
- For each drum rotations
  - sample is dry sieved
  - replaced inside the drum (for another rotation cycle)
Experimental plan – 2nd step

• RCA 4/6.3, 10/14, NA 10/14

• Drum rotations
  100, 300, 500, 1000, 2000

• for each drum rotation
  • new sample
  • Particle Size Distribution (PSD)
  • water absorption (WA)
Experimental plan – dry mixing

- Planetary mixer Skako VSM30
  - rotation speed of 34 tr.min\(^{-1}\)
  - 12 kg dry sample of RCA
  - 10/14 and 14/20 mm
- Mixing times (s)
  10, 40, 60, 120
  300, 600, 900, 1800
- For each mixing time
  - PSD and WA
RESULTS
n° turns, size $\rightarrow$ LA passing

![Graph showing LA passing percentage over LA revolutions for different specifications.](image-url)
n° turns → PSD – RCA 4/6.3
$n^\circ$ turns $\rightarrow$ PSD – RCA 10/14
n° turns & size ➔ WA

Graph showing the relationship between LA revolutions and 2h absorption for different case studies:
- 4/6,3
- 6,3/10
- 10/14

The graph indicates that as LA revolutions increase, 2h absorption decreases.
n° turns, size ➔ RCA density
ANALYSIS
Influence of adhered mortar

"LA_{AM}" = estimation of the LA of the Adhered Mortar

"LA_{NA}" = estimation of the LA of the Natural Aggregate
Influence of adhered mortar

<table>
<thead>
<tr>
<th>Size fraction (mm)</th>
<th>&quot;LA_{AM}&quot;</th>
<th>&quot;LA_{NA}&quot;</th>
<th>&quot;LA_{AV}&quot;</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>14/20</td>
<td>37</td>
<td>17</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>10/14</td>
<td>46</td>
<td>19</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>6,3/10</td>
<td>46</td>
<td>20</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>4/6,3</td>
<td>49</td>
<td>20</td>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

"LA_{AV}" = average of "LA_{AM}" and "LA_{NA}" \( \approx LA_{RCA} \)
LA and dry mixing – RCA 10/14
LA breakage rate

% of initial fraction

LA revolutions

NA 10/14
RCA 10/14
LA breakage rate

![Graph showing breakage rate over LA revolutions for NA 10/14 and RCA 10/14](image)

- Blue triangles for NA 10/14
- Red diamonds for RCA 10/14

**Breakage rate** (1/revs)

**LA revolutions**
Conclusions

• 1.6 mm sieve relevant for RCA
• 500 turns is high but relevant
• Bimodal behaviour of RCA
• Breakage rate correlated to RCA composition
• Breakage rate better indicator?
Thank you for your attention

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