Aggregates Case Study

Use of recycled asphalt and recycled aggregate in the A34 Chieveley/M4 Junction 13 improvement
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| **Product:** | Aggregates for bituminous materials (base course)  
|             | Aggregates for bituminous materials (road base)  
|             | Type 1 Unbound sub-base mixture  
|             | Type 4 Unbound sub-base mixture  
|             | Class 6F2 Selected granular material (coarse grading)  
|             | Class 6F3 Selected granular material  |

| **Material:** | Recycled asphalt  
|               | Recycled aggregate |

| **Application:** | Bitumen bound base  
|                  | Bitumen bound binder course  
|                  | Unbound sub-base  
|                  | Capping |

| **Project type:** | Pavements – roads, car parks, etc. |

| **Location region:** | Chieveley, Berkshire – South East |

| **Date:** | 2003 - 2004 |

| **Specification:** |  |

| **Conditions of contract:** |  |
Activity

The A34 Chieveley/M4 Junction 13 Improvement is a Design and Build project to provide full grade separation of the M4/A34 junction and remove the last ‘bottleneck’ on the A34 between the M3 and M40 Motorways. The works included construction of 3km of new carriageway to take the A34 through a new underpass below the M4 and refurbishment of the M4 adjacent to the junction. The contract value was approximately £38M. The scheme was developed as a sustainable transport solution with focus on continuing the sustainable thought process in the planning, design, construction, hand-over and maintenance aspects of the asset. As part of this process, the requirement for imported primary aggregates was reduced by over 50,000 tonnes by use of in-situ stabilisation of soils, use of locally sourced recycled aggregate from demolition rubble and reuse of recycled asphalt from the redundant carriageway. The recycled asphalt was used as capping, unbound sub-base and in new asphalt for the base and binder courses of the new carriageway.

Comparative performance

The recycled aggregate and asphalt complied with all the specification requirements for the relevant applications. No problems were encountered with placing the materials, and the sections of road with recycled content have performed as well as sections where only primary aggregates were used.

Material detail

Recycled asphalt

Significant quantities of recycled asphalt were obtained at an early stage in the project by surfacing contractor Foster Yeoman from planing works on the M4. The planings were taken to Foster Yeoman’s depot at Theale, adjacent to Junction 12 on the M4, 12 miles east of the site. The asphalt plant at Theale had been set up to incorporate the planings as 10% of the new asphalt base and binder course layers. The planings were screened and processed prior to incorporation into the new asphalt. The bitumen content of the planings was checked, and the binder content of the new asphalt adjusted to take this into account. The planings were used in the base and binder course of the new A34; 28mm HMB base (35 pen) and 20mm HMB binder course (35 pen) respectively.

Some of the planings were retained on site and used as Type 4 unbound sub-base and Class 6F3 capping on the new A34. There was some surplus planings at Theale above what would be required for the new asphalt layers, and planings from other sites were also available. These were blended with limestone to form a 50/50 planings/limestone Type 1 sub-base, which was then returned to the site and used in the new road construction.
Recycled aggregates

From a choice of local suppliers only one was picked as a supplier of recycled aggregate from demolition rubble. Efforts were then concentrated on ensuring that this single supplier, Earthline Ltd., provided a quality product to meet the project needs. Earthline produced recycled aggregate from the processing of construction and demolition material at their depot at Andover. The material was produced according to the BR392 Quality Control: The Production of Recycled Aggregates, and was used as capping on the slip roads to the M4. This amounted to about 10% of the total Class 6F2 capping used on the project. The total amount of granular material that was required for capping was also substantially reduced by using stabilisation of the existing soils with lime and cement.

For a one-off major project the supply from the local market of materials that can be recycled or used more sustainably in construction applications will be limited, especially in a semi-rural location such as Chieveley. The specification allowed more recycled materials to be used than were actually available. The local shortage was due to both a lack of quality and quantity.

The total amounts of recycled asphalt and aggregate used in different applications in the project are shown in the Table 1. A total of 56,000 tonnes of recycled aggregates and asphalt were used, and a further 7,350 tonnes of soil were stabilised. The import of unbound granular fill was limited to 16,650 tonnes of primary aggregates as Class 6F2 capping.

Table 1 Use of recycled aggregates at A34 Chieveley/ M4 Junction 13 Improvement

<table>
<thead>
<tr>
<th>Material and application</th>
<th>Amount (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled aggregates Class 6F2</td>
<td>1,850</td>
</tr>
<tr>
<td>Recycled asphalt Class 6F3</td>
<td>2,580</td>
</tr>
<tr>
<td>Recycled asphalt Type 4 sub-base</td>
<td>17,100</td>
</tr>
<tr>
<td>Recycled asphalt in Type 1 sub-base</td>
<td>25,850</td>
</tr>
<tr>
<td>Recycled asphalt content in HMB base</td>
<td>6,850</td>
</tr>
<tr>
<td>Recycled asphalt content in HMB binder course</td>
<td>1,850</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56,080</strong></td>
</tr>
</tbody>
</table>

The use of recycled asphalt by mass in different applications is shown graphically in Figure 1. Over 80% was used as unbound sub-base, with a further 5% as capping and 14% as reclaimed bituminous material in new asphalt.
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Figure 1  Use of recycled asphalt in different applications on the A34 Chieveley/M4 Junction 13 Improvement

Use of planings on A34/M4 Chieveley

- Capping 6F3: 34%
- HMB Base Course: 5%
- HMB Binder Course: 11%
- Lst/Planings Type 1: 3%
- Planings Type 4: 47%

Specification

The Specification for Highway Works, May 2001 amendments was the specification used on the project. This allowed the use of recycled asphalt for capping as Class 6F3 and recycled aggregate in Class 6F2. Recycled asphalt was permitted as a constituent in Type 1 unbound sub-base up to 50%, and 100% recycled asphalt was permitted as Type 4 unbound sub-base. Recycled asphalt was permitted as up to 50% of new base and binder course asphalt materials, although only 10% was used on the A34 Chieveley/M4 Junction 13 project.

The Specification for Highway Works was further amended in 2004 to introduce the harmonised European Standards for aggregates. These changes do not affect most of the applications for recycled aggregate and asphalt used on the A34/M4. The use of recycled aggregate imported to site as capping would now be classed as Class 6F5 rather than Class 6F2, which is reserved for site-won material. The use of 100% recycled asphalt as unbound sub-base would now be classed as Type 2. Specific approval would now be required for use of 100% recycled asphalt planings as unbound sub-base for roads carrying above 5 msa.

The recycled aggregates were produced in accordance with BR392 Quality Control: The Production of Recycled Aggregates. This document has now been superseded by the WRAP Quality Protocol for the production of aggregates from inert waste.

Cost benefits

Use of the site-won planings resulted in savings compared to imported primary aggregate because the aggregates levy did not apply to the recycled asphalt or the imported recycled aggregate used for the capping. This resulted in savings of £0.80 per tonne for the 50:50
blend of planings and limestone used for unbound Type 1 sub-base material. The use of planings in the surfacing had been envisaged at the tender stage, and an allowance for aggregate levy savings had been made in the rates. The project was let as a lump sum design and build contract. Costain envisaged the reuse of recycled asphalt from the redundant carriageway in their tender as this was allowed by the Specification for Highway Works. If the specification had not allowed the reuse of these materials, the cost to the client would have been approximately £70,000.

Use of recycled aggregates as Class 6F2 capping resulted in savings of £1.60 per tonne because the aggregates levy did not apply to the recycled aggregates.
Details of Parties

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www.highways.gov.uk

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Main contractor
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Client’s Site Representative
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Surfacing Contractor
Foster Yeoman

Recycled Aggregate Supplier
Earthline Ltd
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