Trial of Xeroc concrete-to-concrete recycling on the Ebury Bridge Road project

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1. Background

Concrete plays a crucial role in the construction industry, accounting for over 50% of all building materials used worldwide, due to its durability and low cost. However, concrete is also responsible for about 35% of carbon emissions in construction due to its cement content.

Current concrete ‘recycling’ practice is used for low value fill applications. This does nothing to reduce demand for primary aggregates or the amount of quarrying required.

Xeroc and Westminster City Council (WCC) have been in discussions for some time about improving concrete circularity in Westminster. As a step toward achieving this, a trial was arranged to test the Xeroc approach on one of WCC’s owned projects. The project selected was Ebury Bridge Road.

In February 2024, 4.5 tonnes of demolished concrete was collected from the site with help from JF Hunt, the demolition contractor. This was processed by Xeroc and the materials shipped to Evans Concrete to produce a precast concrete bench for use on the Ebury Bridge Road site.

This is the second field trial of Xeroc’s technology. The first was carried out in late 2023 on a project site in Surrey where the processed demolition waste was returned to the site in a standard mix and poured as pedestrian pathways.

2. Methodology

2.1. Materials Used

The purpose of the trial was to demonstrate the feasibility of circular concrete: taking demolished concrete from the Ebury Bridge Road site and processing it into a precast concrete bench for use on the same site.

At Westminster's Ebury site, six bags were filled with 750 kg demolished concrete each and subsequently transported by Xeroc to the recycling plant in Northern France. This concrete was processed to extract high-quality aggregates, sand, and concrete 'fines'. The recycled material was then sent to Evans Concrete, where they took Xeroc's processed aggregates to build a precast concrete bench.

The project spanned five months from February to June 2024.

Figure 1: Westminster's Ebury Bridge Road site where demolished material was collected.

2.2. Production of Concrete Bench

Unfortunately, the RCF (recycled concrete 'fines' of 0-100 micron particle size) were stored outside at Evans yard and were affected by moisture, resulting in the material hardening. Therefore, the fines were not used as intended to substitute a portion of the cement in the concrete mix. Note that in the earlier trial in Surrey, Xeroc successfully substituted 30% of cement with RCF.

Evans made the concrete bench using their standard concrete mix design but substituted their usual coarse and fine aggregates with Xeroc's recycled materials. The recycled aggregate mix was coarser than Evans standard materials.

The following table shows the weights per volume that were used in the production of bench. The 'coarse recycled aggregate' and 'fine recycled aggregate' highlighted in yellow are the materials provided by Xeroc used in the construction of the precast concrete bench.

Mix design	Kg per cubic metre	Ratio %
WHITE CEMENT	285	11.5
GGBS	160	6.5
COARSE RECYCLED AGGREGATE	1010	40.8
FINE RECYCLED AGGREGATE	870	35.1
SM 550 XP	3.1	0.1
WATER	150	6.1

2.3. Contamination

Although attention was paid to keeping the material free of contamination, some foreign objects were found in the recycled aggregate. Small imperfections became visible once the unit was acid etched as some of the mortar on the surface of the precast washed away.

Figure 2: Foreign objects found in material post-recycling.

3. Results

Evans were satisfied that the bench made with the recycled material met their specifications and produced a high-quality precast piece. The particle size of the coarse aggregates was not optimised for the Evans mix design and was somewhat coarser than their standard material. This will have altered the packing efficiency and is the likely cause for the slightly lower strength results.

Concrete cubes were tested at an external UKAS accredited lab and the average 28-day cube strength for the Xeroc mix ranged between 55.4mPa and 58.5mPa. This is around 10mPa lower than Evans Concrete Standard mix, but it is still more than suitable.

Figure 3: Completed precast concrete bench.

Figure 4: Surface of precast concrete bench.

4. Challenges & Next Steps

1. With the temperamental weather and humidity, it was difficult keeping the ‘fines’ dry even with a covering. Issues to address at the next site include:
    a. Setting aside a specific storage area for the recycled sand, aggregates and ‘fines’ until required for the concrete production to avoid further issues with moisture. Silo storage of the fines will be arranged in the full-scale recycling plant.
    b. Arranging for the recycled fines to be used as soon as they are produced would be ideal as storage will be limited.

2. There were some non-aggregate contaminants in the material. Problems to address include:
    a. Ensuring the recycled concrete is clean and without any contaminants such as plastics, soil, and wood from storage spaces. This will involve a documented inspection protocol
    b. Ensuring recycled sand, aggregates and ‘fines’ are not contaminated by site operations and waste material nearby.