Repairability of Lattice structure in a Circular economy

Mechanical response of 3D printed octet-truss lattice structures under quasi-static tests: compression, tensile, shear, and three-point bending test.

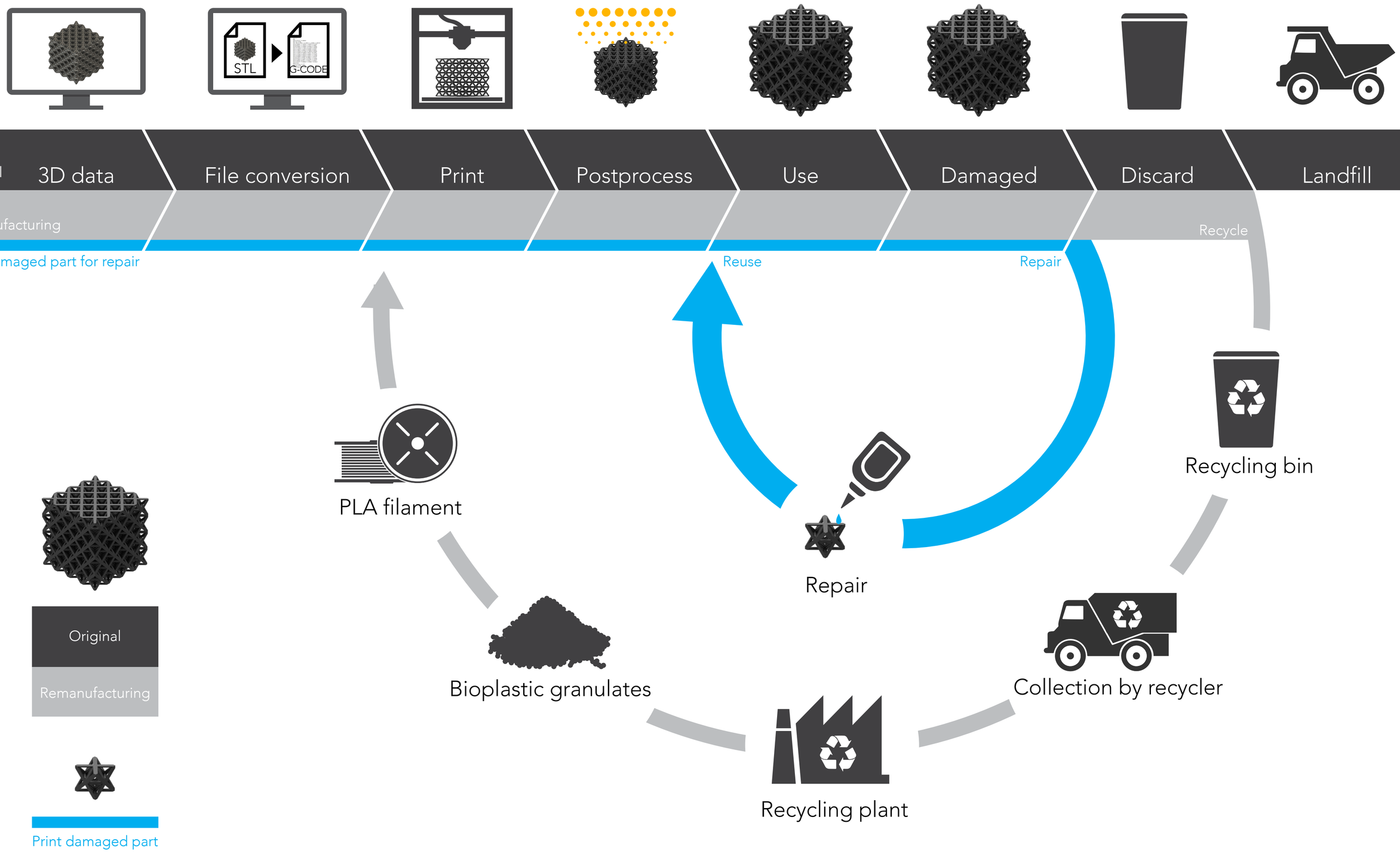

FIg. 1 The flow of repair of the additively manufactured lattice structure adapted from the circular economy model by Ellen MacArthur Foundation.

As illustrated in **Fig. 1**, inner circles (e.g., repair and reuse) are considered more economical because limited resources (e.g., energy, material, labour, etc.) are needed. In the present study, the repairability of lattice structures was studied to extend the lifetimes of lattice-structured products; this would enable the reuse of products and induce people to directly get involved in creating a circular economy.

To determine the factors to be considered for repairing lattice structures, standard specimens fabricated in the form of single undivided and adhesively bonded joint samples were fabricated by fused deposition modelling, and compared under four quasi-static tests:
compression, tensile, shear, and three-point bending.

The **test result** were applied to the consumer product as an example of a guideline for the repair (see **Fig. 2)** in order for the lattice structure to be repaired accurately, prolonging the life cycle of the product.

Test result

- The mechanical reponse of standard and joined specimens were similar in compression and shear test.
- The yield strength in two groups differ considerably in the tensile and three-point bending tests.
- For all the tests, the young's modulus of the joined specimens show marginally lower values as compared to that of the standard specimens, but most of these values are within the standard deviation.

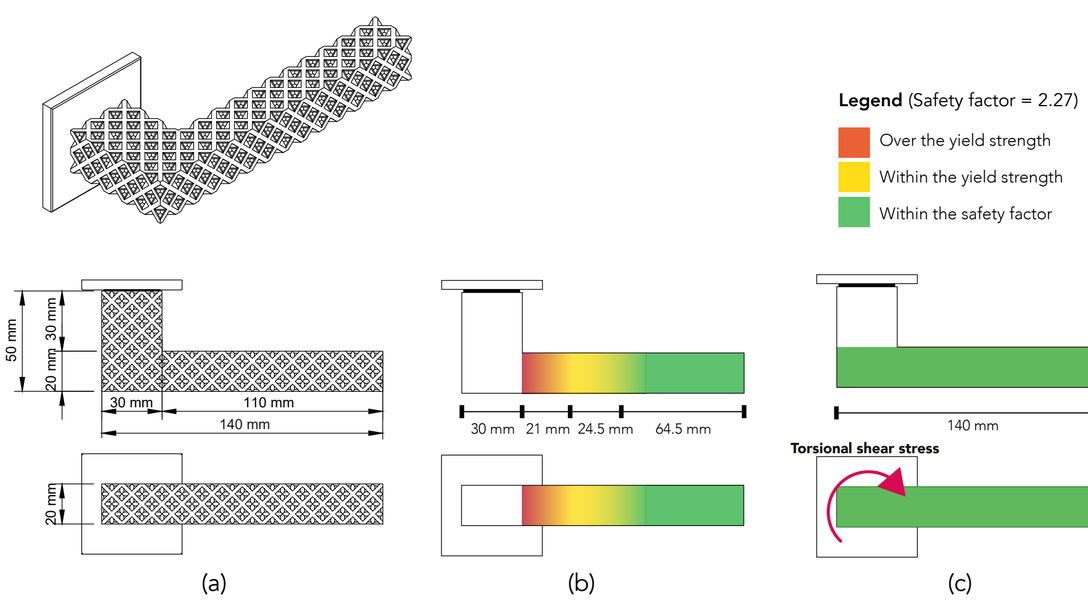

FIg. 2 Example of the guidlines for the repair of the octet-truss lattice structure based on the test result: (a) Schematic view of lever type handle, (b) Repairable area. Green area is where the parts can be repaired with the same safety factors as the original, (c) Using torsional stress in repair to avoid bending stress.

Jiheon Kim
humanVUI - Designing Meaningful Voice Interactions
10 July 2020
Integrated Product Design

Committee Ruud Balkenende
Jun Wu

TU Delft

Faculty of Industrial Design Engineering

Delft University of Technology