

Madeleine Steer – Overview of 4th Year Project

My 4th year project considered the ways in which product disassembly can be used as a teaching resource within the Cambridge University Engineering Department (CUED) and beyond. Developing a thorough understanding of the intricate relationships between material selection, processing, microstructure, properties and design can take years. A more hands-on approach to teaching design for manufacture has been shown to be very effective; my project recommended areas where disassembly could be used more within CUED, in order to distribute its advantages to the students. It also considered how the results and benefits of product disassembly can be conveyed to students who do not have the means to perform disassembly themselves.

First, a thorough evaluation of disassembly already being used as a teaching resource within the University of Cambridge was performed. This included a review of areas in which there was potential for disassembly to be integrated as a teaching tool within CUED. From this evaluation, the exact aims of this project were defined: to explore the feasibility of a new CUED disassembly outreach activity; to consider the possibility of integrating disassembly practicals similar to those performed elsewhere in the University into the CUED course itself; to further develop the Granta Design web resource. This is a prototype HTML-based website that demonstrates design for manufacture through the use of disassembled case study products and is designed to support disassembly activities.



Before work on the integration and development of new disassembly resources began, a case study project—the disassembly of a washing machine—was performed. This provided an opportunity to explore how the disassembly of a multi-component product could be used to create teaching resources. It was found that documentation of the disassembly process was crucial in order to avoid losing

or overlooking information. The material gathered from the disassembly case study was used to generate prototype web resources, including a worksheet on embodied energy. Overall, the washing machine was deemed to contain too many components to be of use as a case study product for the Granta Design web resource. It was concluded that products with between 2 and 10 components would be more suitable.

Leading on from the case study project, the Granta Design web resource was developed and expanded. This is a manufacturing teaching resource in the form of a HTML-based website; it is similar to the Cambridge Engineering Selector (CES) EduPack software used by many universities and institutions around the world (and is produced by the same company). However the new web resource uses comprehensive case studies of products to clearly demonstrate notable materials and processes and why they were used, whereas the CES EduPack software is more encyclopaedic. Dr. Shercliff (my supervisor) provided a selection of hand tools that were no longer of use. These tools, which mostly contained components made of ferrous metals, were used to continue populating the web resource. The hand tools with the most potential to showcase specific manufacturing principles were disassembled, after which metallographic samples of the ferrous metal components were prepared. These were analysed to determine the microstructure of the components and confirm the

manufacturing processes that had been used. The data and micrographs generated by the hand tool disassembly were compiled and transformed into selected mock-up web pages, one of which can be seen at the bottom of this article. Although these were based on the layout and structure of the already existing web pages, some additions and alterations were made to enhance the resource—in particular, sections on microstructure and the corresponding material properties were added to both the product and process pages. Thought was given to how these web pages should link together to make the website easy to navigate for the user; to this end a site map was generated. An assessment of the mock-up web pages acknowledged that although progress had been made with the development of the resource, there was still more work to be done and it was recommended that the web resource be trialled as soon as possible.

Besides the Granta Design web resource, other areas which showed potential for the integration of disassembly teaching resources were also explored. A suggestion was made for a new CUED outreach activity, where Key Stage 2 students would disassemble an inexpensive consumer product (in this case a battery-operated fan), discuss the product's components and then reassemble it. This activity would give students an exciting and informative insight into materials selection and engineering design, and allow them to learn more specifically about plastics and moulding, which is part of the National Curriculum. An assessment of how disassembly practicals could be integrated into the CUED course itself was also performed. A new IIA Extended Activity or Project, where groups of students would be given a product to disassemble and analyse, was suggested as the most promising option. This would be beneficial to students (especially those who had studied 3C1) as a hands-on experience where they would explore the materials, processing and design considerations made when designing for manufacture. There would, however, be limitations on this activity, due to the restricted metallographic sample preparation capabilities in CUED (compared to IB Materials Science where a similar practical is performed). Both of these new suggested activities would require more development and testing to ensure that they deliver useful and interesting knowledge to the students involved—this is recommended to be undertaken by a successive IIB student. The establishment of a rotating display of disassembled products in the Dyson Centre is also recommended.

Several avenues where disassembly could be used as a teaching resource were pursued and investigated. Some existing resources, such as the Granta Design website, were extended and improved. New activities and projects that would help to bring the benefits of disassembly to more students within CUED were also suggested. My 4th year project considered the ways in which product disassembly can be used as a teaching resource within the Cambridge University Engineering Department (CUED) and beyond. It set up and recommended various directions that could be taken by a future IIB student to further explore this area of research.