A BACKGROUND TO ENGINEERING DESIGN

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Preface

'Design' is a popular expression with varying implications: wallpaper design differs from dress design, 'industrial design' differs from engineering design. Some journals go so far as to use the word design for the external aspects of a machine, calling the insides, a little airily, the 'engineering'; for example, a teleprinter was described as designed by a designer particularly well known for elegant tableware, the makers of the works were mentioned a long way further down in the 'credits'. Engineers in turn insist that the word should refer almost entirely to the works, or in simple cases to the stressing.

This semantic difference is best resolved by those engineers who themselves display a strong sense for the appearance of a product and are prepared to recognise that those trained mainly in the visual arts and relatively free from mechanical habits can have something refreshing to offer.

The present book is concerned almost entirely with functional aspects; indeed the author feels that not only in machinery should the externals generally take their place with all the other considerations; for instance in light-fittings, efficiency and styling can be at loggerheads. Only where the function is simple and sufficient strength easily provided, as in furniture, can external design take precedence. Occasionally the function and ease of making actually suggest a happy shape.

Engineering design at its most restricted is finding the right thickness for a part when shape, function, loading and material are pre-decided. As will be seen later, even this is not always easy. Higher levels of elaboration are reached in 'shopping-list' design, finding the most economical and/or versatile process plant or production line consisting of standard but expensive items of equipment. The most creative design activity, starting from basics, is also the most demanding if it is not to consist of repeating old mistakes along with inventing a few new ones.

This book does not supersede any established manuals but brings together key points from the past and more recent data. The references include items dating back seventy years but the majority are only a few years old.

To avoid items like 'this is a bolt, this is a clamp, this is a keyway', familiarity with the names and uses of basic mechanical components is assumed, as is a knowledge of basic stress and strain relations appropriate to first- or second-year undergraduates in engineering.

To reduce tediousness, extensive explanations have been avoided; it is felt that the intended reader is better served by erring on the side of brevity, leaving room for thought yet, it is hoped, no room for misunderstanding.

Standard drawing conventions have been varied slightly in the interests of

clarity; each figure should be considered independently. Generous use of shading, though unnecessary for many, should help to minimise uncertainties for those students who are unfamiliar with machinery details.

To avoid irritating brackets, SI units are used generally, though occasionally Imperial units are shown. For stresses, a convenient set of figures to relate the more common units together is the ultimate strength of a low-carbon steel, 28 tons/in.^{2} $\approx$ 400 MN/m^2 $\approx$ 60 000 p.s.i. (= lbf/in.^{2}).

Apologies for digressions, approximations, simplification of facts and verbal short-cuts are tendered here and now, in bulk.

The author gratefully acknowledges his debt to all those who taught him or provided opportunities for learning and experience.

Thanks are due to Sheffield University for the help received from the Applied Science Library, the photographic section, the workshops and laboratories of the Mechanical Engineering Department and for a certain amount of clerical assistance; also to Sheffield City Library which was found to form a most useful complement to the University library.