Industrial relevance in Engineering Education: Solving the accreditation faculty resource dilemma

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Concentrating on Engineering Science

“This emphasis produces graduates with strong technical skills…

…but graduates are not well prepared in other skills necessary to develop and manage innovative technology”.

Faculty time and research culture dilemma

Accreditation authorities agree Universities should retain the Engineering Science approach but compensate with industrially-relevant curricula.

Specify programme outcomes not detailed curricula.

Warmly received by industry but not widely adopted…

…because of their faculty labour-intensive character and inconsistency with the academic research culture that dominate most large [U.S.] engineering schools.

EUR-ACE Accreditation Criteria

The EUR-ACE framework lists six Programme outcomes for accreditation:

- **Knowledge and Understanding**
- **Engineering analysis**
- **Engineering design**
- **Investigations**
- **Engineering practice**
- **Transferable skills**

University Time and Resource Dilemma

Faculty without tenure must "Publish or Perish".

BUT to remain accredited, Universities must provide industrially-relevant courses…

…that prepare students for professional careers.

Research-oriented Faculty and Design Courses

Most faculty members have a very strong research background…

…but limited <u>current</u> practical industrial experience of activities relevant to industry-bound students.

The six outcomes – the dilemma

Significant time is required to prepare lectures…

…to properly teach a variety of topics in the wider context of engineering.

The six outcomes – the dilemma

Is there time to keep up-to-date?

Is there the time, experience, desire and understanding to teach engineering design as practised in industry?

Will this time contribute to tenure?

The six outcomes – the dilemma

Data and simulation software are necessary to conduct engineering design, analysis and investigations…

…and to introduce new and emerging technologies…

But must actually be used in Industry for accreditation.

The six outcomes – the dilemma

Are methods and software used in Industry available…

…that students can RAPIDLY and EASILY use to gain experience of design and engineering practice?

To provide industrial relevance vital for accreditation, it is logical to adopt resources used by the companies who will employ graduates capable of using them!

A solution to this time and resource dilemma?

IHS ESDU provide validated, authoritative engineering data, methods and software for designers, analysts and educators.

Over 1380 documents with 250 computer programs produced since 1940.

Endorsed by professional institutions and…

…used by engineers throughout the world.

Globally-accepted by the aerospace industry.

ESDU has a superb reputation in Industry. But…

Widely considered to be the most accurate, up-to-date and comprehensive collection of validated 'data'.

A vast resource of relevant theoretical methods with guidance and examples of their practical application to real engineering situations.

But can ESDU data be easily and readily adapted for educational uses to solve the faculty time and resource dilemma?

ESDU's inclusion in University programs

IHS ESDU provide validated methods, data and software used in Industry, suitable for simple, rapid inclusion in these engineering programs:

- **Mechanical**
- **Aerospace**
- **Chemical / Petro-chemical**
- **Civil**
- **Structural**
- **Material and Environmental science**

Who uses ESDU in Universities?

Over 120 universities worldwide subscribe to the service.

ESDU are a member of the American Society for Engineering Education (ASEE).

How does ESDU assist University subscribers?

1. **Data are cut-and-pasted from documents (called Data Items) and included in lecture notes, assignments, handouts, visual aids, etc. – all enhanced by software.**

2. **Projects, thesis work and internal research use the definitive industrially-validated ESDU methods.**

3. **Curriculum guidance, teaching modules and 'Short Courses' are provided in the ESDU University guide.**

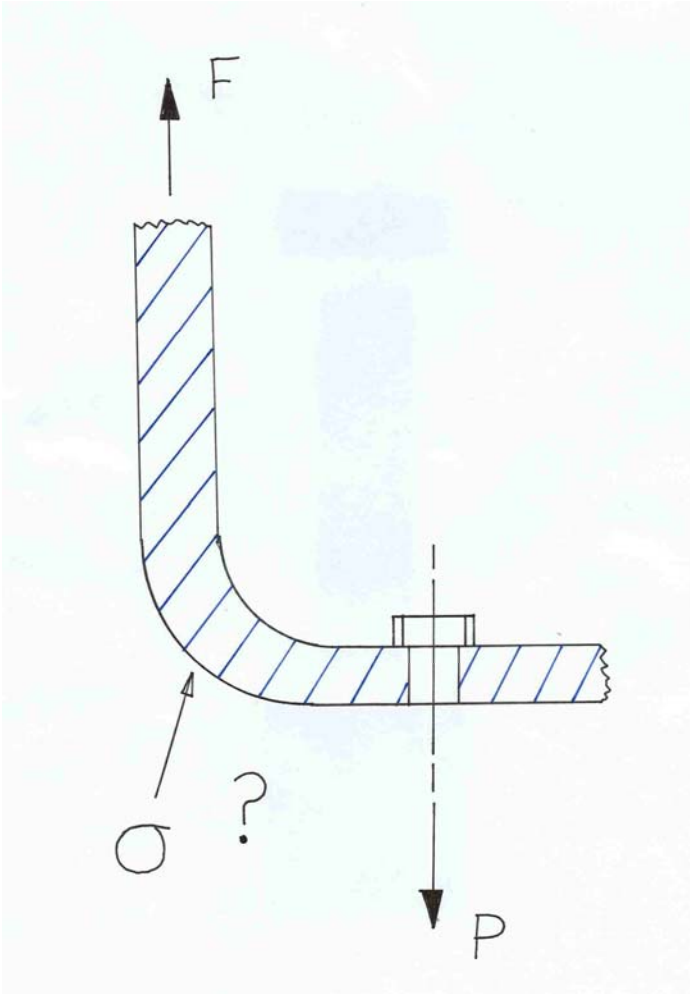
4. **Faculty are <u>encouraged</u> to work with ESDU Engineers.**

ESDU in the curriculum – an example

Mechanical Engineering – Curved beam stress analysis.

The old way…

ESDU in the curriculum – an example

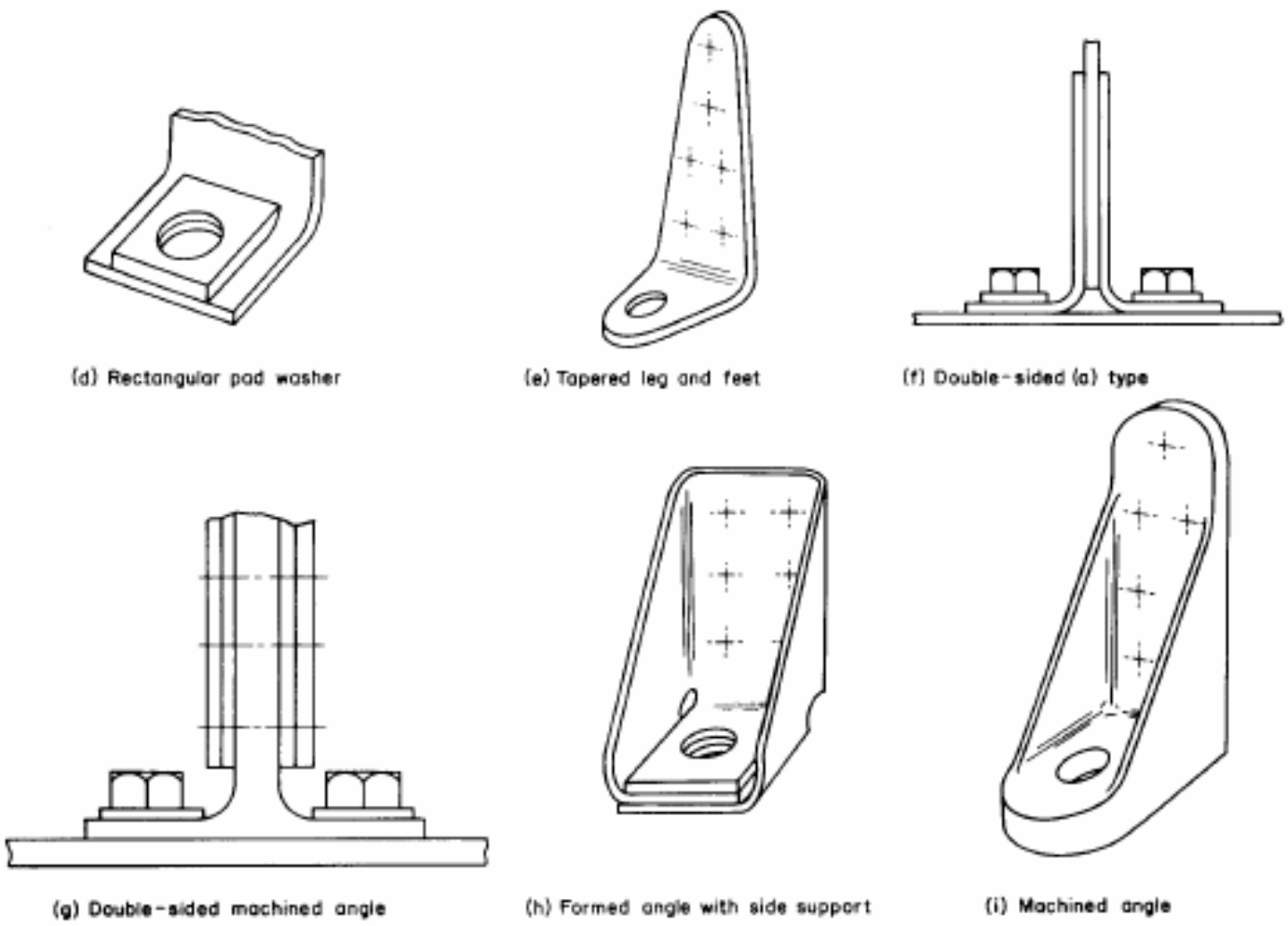


ESDU in the curriculum – an example

Mechanical Engineering – Curved beam stress analysis.

The ESDU way!

ESDU in the curriculum – an example



(d) Rectangular pad washer

(e) Tapered leg and feet

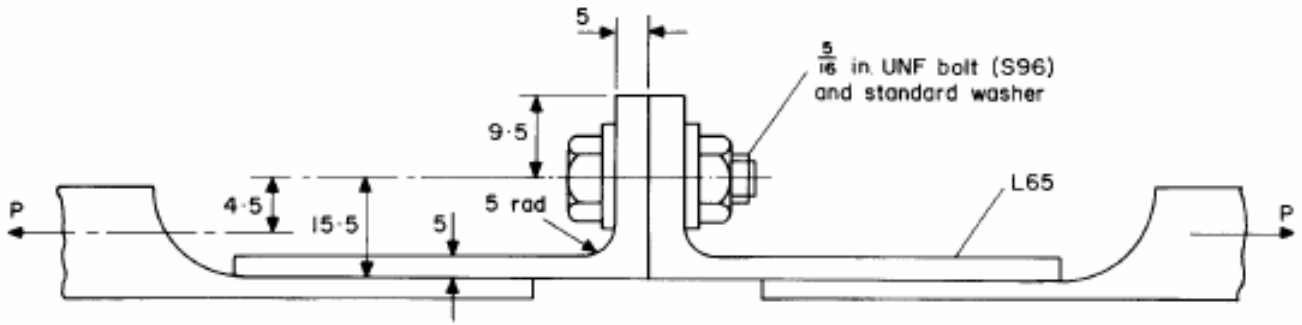
(f) Double-sided (a) type

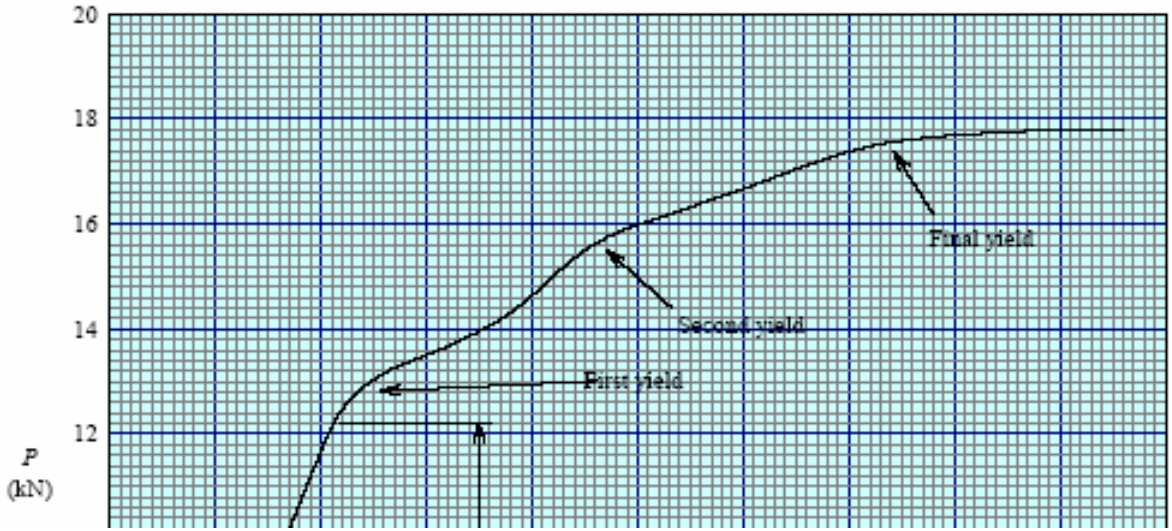
(g) Double-sided machined angle

(h) Formed angle with side support

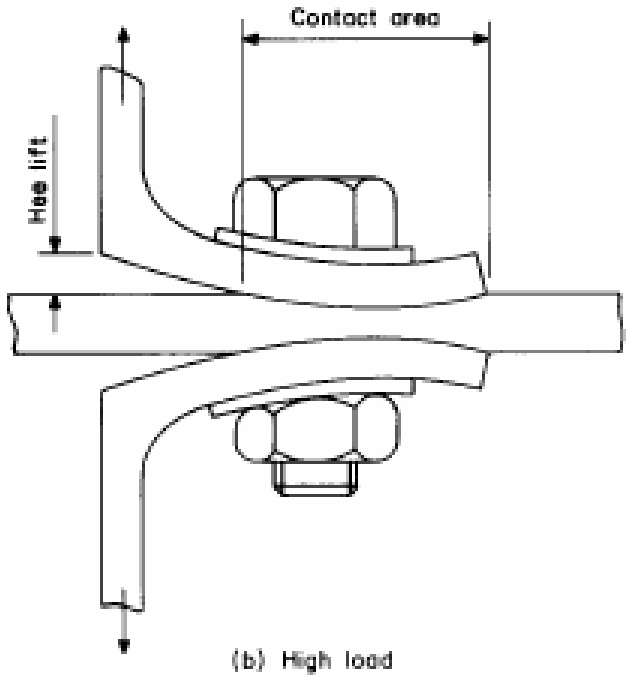
(i) Machined angle

ESDU in the curriculum – an example





ESDU in the curriculum – an example



Sketch 4.2 Showing that contact area decreases with increasing loading

ESDU in the curriculum – an example

The foot can fail in shear. The maximum shear stress in the foot occurs at the centre of the foot and its elastic value is given by

$$q_f = 1.5P/(w_f t_f) . \qquad (4.1)$$

The value of q_f will be greater than that given by Equation (4.1) if the extreme fibres of the foot have yielded.

In designs where the foot and leg are formed from a strip, as, for example, that shown in Sketch 2.2(a), the stiffness of the foot is very low in relation to that of the bolt and the leg (including its associated structure). In these cases a simple model of foot behaviour can be constructed in which the bolt is taken to be rigid but leg rotational restraint is included, (see the sketch with Figure 3). The equation for the bending moment at the side of the bolt is given by

$$M_b = Pc\left[1 - \frac{w'_n}{2c} - \frac{1}{2}\left\{\frac{1 - w'_n/(2c)}{1 + 1/[(\mu_f c/E_f I_f)(1 - w'_n/(2c))]}\right\}\right] . \qquad (4.2)$$

The assumption of a rigid bolt head gives a conservative estimate of M_b. Effective values of w'_n should not exceed the across flat dimension for the bolt head or nut. In wide feet, with w_f greater than say $2w_n$, the value of w'_n is probably close to zero.

Conclusions

The ESDU product and service is a solution to the time and resource dilemma that university faculty face…

…applied by over 120 universities and contributing …

…toward satisfying their accreditation criteria.

There will never be a total solution to the faculty time and resource dilemma.

But ESDU provides a significant contribution!

What's next?

www.ihsesdu.com