

Weld-in-Search Service

DESIGN OF WELDMENTS—PART III

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The classified subject selected for this issue of the IWJ is Design of Weldments—Part-III. Part I & II have been published in April '83 and Jan. '85, issues of the journal. Each of the retrieved articles is referred to by a WRI file number, title of the article, the author (s) name, journal code with volume and issue number. These details are followed by the abstract and keywords of the article.

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1. **008001** *Interpretive report on operative conditions for Nuclear pressure vessels. SMITH K. F.*

WRC No. 066. 01.66

Abstract : This report attempts to summarise the status of nuclear pressure vessel operating parameters, and is addressed particularly to vessel fabricators and to Committees charged with framing pertinent specifications. Although there are several different types of nuclear reactors, based on the type of cooling medium used, this report is confined to aqueous type reactors mainly. Water-cooled reactors to date have the benefit of the acquisition of more operational history than other types. Operating conditions are herein defined to include only those parameters of importance to vessel integrity and a description can be based only on those reactors having had some significant operating history. Some of the information given exists in published form in various documents, other important portions are unpublished to date. Serious gaps in the data and the need for confirmatory work will become apparent from the discussion.

Keywords : Pressure vessels ; Nuclear Engg ; Design ; Corrosion ; Radiation ; Impact strength.

2. **038086** *Criteria for the design efficiency of weldments. VERETNIK. L. D.*

**W.P. Vol. 15
No. 006.68**

Abstract : A procedure is outlined for assessing the extent to which the design of weldments is appropriate to the fabrication techniques to be used. The term 'design efficiency' is defined, with reference to the criteria to be adopted for comparing alternatives. Eight such criteria are proposed, with formulae for their use. The optimum level of efficiency can be attained if the designer and production engineer can co-operate in implementing scientifically sound measures for guaranteeing its attainment, and can apply a suitable system of criteria for objective evaluation. The basic requirement for success in implementing measures to improve design efficiency is the development of these measures when the work is still at the drawing office stage. It is difficult to improve the design of weld-

ments already in production. This article is concerned with the system developed and put into practice for evaluating the design suitability of weldments.

Keywords : Welding ; Design ; Welded joints ; Structures ; Weldments ; Efficiency.

3. **041004** *Structural stability & design provision—A comparison of the provisions of the CRC guide—The specifications of AASHO, AISC & AREA. YEW. B. T., HUANG. J. S. PATTERSON. P. J. BROZZETTI, J.*

WRC V. 146, No. 11.69

Abstract : The purpose of this report is to examine the stability provisions of the specifications of the American Association of State Highway Officials (AASHO), the American Institute of Steel Construction (AISC), and the American Railway Engineering Association (AREA) and to compare them with pertinent recommendations of the Column Research Council (CRC)—'Guide to Design Criteria for Metal Compression Members'. The major

specifications selected are those dealing with buildings and bridges, structures which have been of particular interest to the council in the past. This is used as a reference and as the basis of many design provisions. The arrangement of the material in this bulletin is according to the sequence of the 'Guide'. Topics such as arches, hybrid girders and box girders which are not covered in the guide but are treated in the specifications, are listed at the end of the comparison. A table of contents, arranged in tabular form, proceeds the detailed tabulation of provisions. A comparative nomenclature (symbols) is included in the appendix.

Keywords : Comparisons; Design; Geometry; Specifications; Structures; Standards; Codes of practice.

4. 041126 *Fixtures and manipulators for mechanised arc welding.*

SPENCER PAYNE

WJ V. 048, No. 012.12.69

Abstract: This is an article dealing with mechanisation aspects in welding fabrication industries to improve productivity, economics and quality of finished products in general. Fixtures and manipulators for mechanised arc welding at a work station require that the work fixture be integrated with the welding equipment fixture and that careful attention be given for clamping, weld backing, grounding, weld cycle timing and arc blow. The objective in fixturing is to take maximum advantage of mechanised welding's ability to lower welding costs and increase productivity. Different classifications of fixtures are indicated alongwith suitable diagrams. Selection of fixtures for a particular work is discussed. The design procedures of fixtures and manipulators are also indicated in this article.

Keywords : Clamps; Design; Development; Electric Arcs; Fixture; Manipulators; Welding; Automation.

5. 045003 *Significance of Fracture Extension Resistance (R curve) factors in fracture safe design for Nonfrangible metals.* PELLINI. W. S. & JUDY. JR. R. W.

WRC No. 157 December 70

Abstract : Requirements for new directions in fracture research emerge from considerations of the basic lack of applicability of K parameters for definition of the fracture extension resistance of nonfrangible metals. New research is required into factors relating to the increase in plastic work energy resistance defined by R curves. A case is presented for the mutual consideration of metal-type structure-type relationships in fracture-safe design. Present fracture-safe design practices do not include a rational approach to this question. The report provides an introduction to these considerations in terms of extension of fracture mechanics concepts, as well as metallurgical factors and engineering practices. Data presentation of R-curve research is limited to illustrative examples, which document the reality of fracture extension processes in determining conditions for structure failure. A rationale is presented for the use of the dynamic tear (DT) test in standard and modified configurations, which provide for definition of R curve features. Indexing of the R curve features to the Ratio Analysis Diagram (RAD) adds new dimensions to analytical capabilities of this system. The integration of mechanical, metallurgical and structural aspects which emerge should provide for significant advances in treating the fracture-safe design problems of nonfrangible metals and compliant structures.

Keywords : Composition ; Design ; Metallurgy; Fractures; Fracture tests; Fracture mechanics; Mech. properties; Significance; Metals.

6. 045180 *Designing to avoid brittle fracture in weld metal.* DAWES. M. G.

MCBWJ V. 002

No. 000.02.70

Abstract : For many years weld metals for structures designed to avoid brittle fracture have been chosen on the basis of what now appear to be rather arbitrary tests and conflicting requirements. This knowledge has resulted from the gradual development of fracture mechanics which now provide a sound basis for examining some of the anomalies of the past. This article is based on the first of a series of Research Members' Reports that describe an extensive investigation of weld metals by means of general yielding fracture mechanics. This article deals with the effect of specimen size, loading rate and notch acuity on the resistance to fracture initiation of a range of commercially available weld metals. Investigations are made by using different welding processes such as manual metal arc welding, submerged arc welding, electroslag welding and CO₂ gas shielded arc welding.

Keywords : Design ; Development ; Mech. properties ; Steels ; Welding ; Metallurgy; Brittle fracture; Brittleness; Fractures;

7. 045203 *Residual stress in welded maraging steel sheet.* LUXMOORE. A, KAN. D.K.Y. & EGAN. G. R.

MCBWJ V. 002 No. 006.03.70

Abstract : A near-spherical rocket motor casing has been constructed from welded maraging steel sections. The residual stresses introduced by

welding have been measured by the Moire technique, and the effectiveness of various thermal and mechanical treatments in reducing these stresses was investigated. The results indicate a most unusual residual stress distribution across the weld, with the maximum tensile stresses occurring on each side of the weldment. This is probably connected with the peculiar behaviour of maraging steel during a heating cycle, when a considerable grain reorientation occurs. In order to remove any residual stresses caused by welding, a small structure can be annealed, but in this case the small wall thickness and highly curved shape could easily lead to gross deformation during such treatment. As there was a possibility of a stress controlled failure mode, e.g. stress corrosion or hydrogen embrittlement, it seemed desirable to measure the residual stresses to see if any heat treatment was necessary. As a corollary to this, the effectiveness of various thermal and mechanical treatments in reducing such stresses was also examined.

Keywords : Design; Heat treatment; Maraging steels; Mech. properties; Residual stresses; Stress analysis; Welding; Steels; Applications; Rockets; Motor vehicles; Fabrication.

8. 045209 *Fracture Mechanics—test specimen design.* EGAN, G. R.

MCBWJ V. 002
No. 006.06.70

Abstract : Crack opening displacement fracture tests now form the basis of a method of determining the critical flaw size for failure by brittle fracture. It is now well established that the two approaches to fracture toughness, K_{IC} and COD are compatible. As far as specimen design is concerned it would be preferable in all cases to test a linear elastic fracture mechanics K_{IC} specimen

in which the crack length, thickness and ligament are all equal since this specimen geometry has the greatest capacity to measure K_{IC} for a particular value of yield stress. However, in a lot of cases, particularly when testing material which has been subjected to welding treatments or when a particular region of a welded joint is to be assessed, it is inconvenient to use a notch of length equal to the plate thickness. It is proposed that in these cases the recommended specimen section should have a square ligament so that the width is equal to the thickness plus the crack length. Different specimen preparation sketches are also indicated in the article.

Keywords : Development ; Test pieces; Fratures ; Fracture tests ; Fracture mechanics ; Mech. testing ; Design ; Welding.

9. 050308 *New manual calculating, designing and making welded constructions.* (Author unknown)

IIW Doc.XIV 320.71

Abstract : This paper is offered to inform the members of IIW about the new manual published in the USSR in 1971. The manual is mainly intended for training students of higher educational establishments, specializing in welding in machine building. The manual covers both the calculation and design of welding constructions and technology of making welded constructions. These two subjects follow the study of theoretical mechanics, strength of materials, elements of machines and other subjects that provide a necessary scientific basis. Besides that the new manual includes chapters required for the study of strains and stresses in welding and special problems of welded joint strength. The manuals published before 1971 deal either with the problems of calculating and designing welded structures or with

the technology of producing structures. These two aspects of the process of making a welded structure are closely linked, the separate study inevitably led to the necessity of including some information. The sequence of presenting the material in the new manual is also indicated.

Keywords : Welding; Education; Design ; Computation ; Structural members; Structures ; Reviews ; Data.

10. 057029 *Design for large diameter columns with thin walls.* (Author unknown)

WDF V. 046.08.73

Abstract : Long cylinders with thin walls under compression do not follow the same laws as small-diameter pipe columns. Designers use long established column rules and formulas for small diameter pipe under compressive loads. However, conventional methods do not hold for columns with large diameters and thin walls. The tubular column design handles structures under axial compression loads. Other loadings require more complicated analysis. Wind loads and induced vibrations are typical other loadings. The tubular column design does not take into account secondary loadings. This article illustrates a simple method for designing. Extensive experiments had been demonstrated that vertical axial loads and the area of a tubular column section are related to allowable stresses for various conditions.

Keywords : Design ; Structures ; Structural members; Columns; Thickness; Diameter; Size; Fabrication; Pipelines; Tubes & pipes; Diagrams.

11. 057098 *Design, construction and calibration of a 120000ft. lbf capacity drop-weight testing machine (in three parts.)* EGAN, G. R.

WRI V. 003
No. 003.03.73

Abstract : As ever-increasing emphasis is placed on fracture control procedures for all types of welded plant it becomes increasingly important to consider the fracture problem as a whole. The assessment of crack propagation behaviour is important when a single item of plant which is at risk of fracture may cause serious damage to the rest of the complex. In these circumstances it is as well to adopt a 'belt and braces' attitude and having set flaw size limits for fracture initiation, to go a step further and explore what would happen in the event of fracture initiation. The three papers in this series explain the concepts of fracture control in relation to propagation, and they outline the construction and calibration of large drop-weight testing facility. Part 1 is concerned with the design philosophy. Part 2 will describe the design, construction and calibration of the machine.

Part 3 deals with the calibration and commissioning tests that were required to enable energy/temperature curves to be obtained.

Keywords : Design; Construction; Test equipment; Machinery; Quality control; Mech. testing; Fracture tests; Calibration; Welding; Fabrication.

12. 058303 *On the rational design of welded vessels and pipes from dissimilar materials.* BOGOMOLOVA. A. S.

WP V.020 No. 009.09.73

Abstract : It is shown that a thin transverse soft interlayer in a thin-walled pipe (vessel), working under the action of internal pressure, is in the state of triaxial stress and axisymmetric strain in the plastic stage of deformation. Tubular components and vessels from dissimilar materials, satisfying the requirements of high temperature strength and corrosion resistance, and also the requirements of minimum weight, are used on an increasing scale in various branches of industry. Difficult-to-weld materials are joined by means of transition pieces welded

by explosion welding. In this case use is made of simple two-layer transition pieces from the same materials as those of the structures, and also of composite transition pieces consisting of 3-4 layers. The question of the strength of welded joints with composite transition pieces has been discussed here in greater detail. The data given shows that four-layer composites shown in figure are characterised by a marked mechanical heterogeneity. In the titanium steel composite this layer is represented by copper. In the case of biaxial tension, the effect of contact hardening depends also on the wall thickness of a vessel (pipe) and the position of the interlayer in relation to the axis of the vessel (pipe). Typical diagrams of vessel design with transverse interlayer are given in the article.

Keywords : Welding; Design; Pressure vessel; Pipelines; Tubes & pipes; Dissimilar Metals Pressure parts; Standardization; Fabrication; Data. ●

Welding Spatter,

"Deadly Maintenance"

—HSE report on accidents in industry

Health and Safety Executives, 259 Old Marylebone Road, London, NW1 5RRR has brought out three reports, prepared over a three year period, highlighting the main danger areas :

1. Deadly Maintenance : Plant & Machineries
2. Deadly Maintenance : Roofs
3. Deadly Maintenance : A study of fatal accidents at work.

It was noted during the compilation of these reports that welding accidents occur in the actual working area rather than in any defects of the equipment itself. Welders know what sort of gear to wear and are generally competent at handling equipment, but accident occur when they are not familiar with the working environment. For example, two welders needed to reach a high place when they were working and used a barrel to stand on. Inside was a large amount of oil which caught fire as a result.

The message for industry was—"Give safety in maintenance your sincere and immediate attention, whichever industry you may be in. The death toll is high and avoidable. It is not money but some thought, some foresight, and some system that will produce the result we all want."

—adapted from a report published in **Welding & Metal Fabrication**, May/June, 1985.