

DESIGN OF LIFTING LUGS

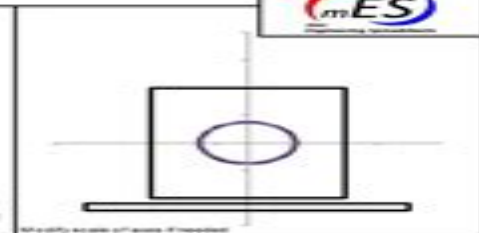
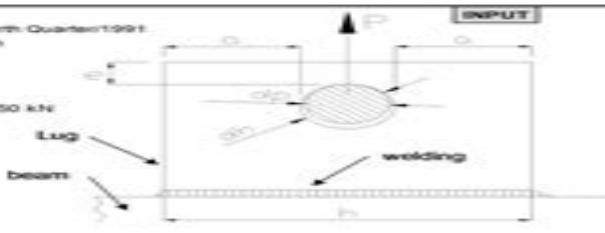
Reference: Design and Construction of Lifting Beams
David T. Ricker, PE, ASCE Engineering Journal, Fourth Quarter 1991
Updated to 2005 ASCE Manual of Steel Construction
ASCE 2005

Date and project ref.:
Designed by: XXXXXX
Company: XXXXXX

Select Units System: S.I.

Unfactored lifting load, $P = 50$ kN
Safety Factor, $S.F. = 1$
Pin diameter, $d_p = 29$ mm
Lug hole diameter, $d_h = 30$ mm
 $a = 15$ mm
 $e = 25$ mm
Lug plate Thickness, $t = 20$ mm
Lug yield stress, $F_y = 235$ MPa
Lug ultimate stress, $F_u = 360$ MPa
Welding length $h = 60,00$ mm

$P = 11,24$ kips.
 $P \cdot S.F. = 11,24$ kips = 50 kN
 $d_p = 1,14$ in.
 $d_h = 1,18$ in.
 $a = 0,59$ in.
 $e = 0,98$ in.
 $t = 0,79$ in.
 $F_y = 34,06$ ksi.
 $F_u = 52,21$ ksi.
 $h = 2,36$ in.



Geometry Checks:
 $d_p < d_h - 1/16"$? No. Pin is considered fitting the hole.
 $a \geq 2t$? No. Increase a or decrease t.
 $a \leq 2t + 63"$? Yes. Use full value of a.
 $a \geq d_h/2$? Yes. Plate proportions are correct.
 $t \geq 1/2"$? Yes. Plate proportions are correct.
 $e \geq 0,67d_h$? Yes. Plate proportions are correct.
 $t \geq 0,25d_h$? Yes. Plate proportions are correct.
 $h \geq 2a + d_h$? Yes. Welding length is correct.

Capacity Checks (capacity values without S.F.):
Failure mode 1 $P_t = 48,56$ kips = 216,0 kN, Tensile Rupture of Lug.
Failure mode 2 $P_p = 27,58$ kips = 122,7 kN, Bearing Capacity of Pin on Hole.
Failure mode 3 $P_s = 21,13$ kips = 94,0 kN, Shear Yielding to Edge of Plate.
Failure mode 4 $P_e = N/A$ kips = N/A, Tension Tear Out to Edge of Plate

Verification
Failure mode 1 O.K. $S.F. = 4,32$ $2 \cdot MPA(29+63)/170$ Pg. 151 of Reference, Equation (D5-1) of Manual.
Failure mode 2 O.K. $S.F. = 2,45$ $2 \cdot 70 \cdot 170/170$ Pg. 152 of Reference, Equation (D7-1) of Manual.
Failure mode 3 O.K. $S.F. = 1,38$ $2 \cdot 170 \cdot 170/170$ Pg. 152 of Reference, Equation (D3-1) of Manual.
Failure mode 4 N/A. $1,67 \cdot 2 \cdot 170 \cdot 170/170$ Pg. 152 of Reference, with $P_t = 0,67 F_y$.

Checks of lug bottom section:
 $F_{ax} = h \cdot t \cdot f_y = 282$ kN Tension resistance of the section
Verification O.K. $P \cdot S.F. = F_{ax}$

Welding verification

Material of bottom beam

Yield of bottom beam, $f_y = 355$ MPa
Ultimate stress of bottom beam, $f_u = 555$ MPa



Welding verification (type 1, fillet welding)

Geometry
Welding length, $h = 60,00$ mm
Number of welding chord, $n_w = 2$
Welding
Welding throat, $a_w = 5$ mm
Side t_a of weld, $t_a = a_w \cdot \sqrt{2} = 7,07$ mm
Load
Load, $N_{ax} = P \cdot S.F. = 50,00$ kN



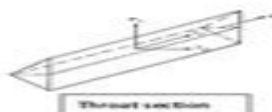
Materials

Yield of the lug, $f_{yL} = 235,00$ MPa
Ultimate stress of lug, $f_{uL} = 360,00$ MPa
Yield of bottom beam, $f_{yB} = 355,00$ MPa
Ultimate stress of bottom beam, $f_{uB} = 510,00$ MPa
Yield of the weakest component, $f_y = f_{yL} = 235,00$ MPa
Ultimate stress weakest component, $f_u = 360,00$ MPa

$\gamma_{M0} = 1,25$
 $\gamma_{M1} = 0,5$
 $\gamma_{M2} = 0,8$
 $\gamma_{M3} = 1$
User value

Stresses on the throat section

Verification as per method of Eurocode 3 EN 1993 1-8:2005
 $\sigma_{t1} = N_{ax} / (n_w \cdot h \cdot a_w) = 58,93$ MPa
 $\sigma_{t2} = N_{ax} / (n_w \cdot h \cdot a_w) = 58,93$ MPa
 $\tau_{v1} = 0$
 $\tau_{v2} = 0$
 $\sigma_{t1} = (\sigma_{t1}^2 + 3 \cdot (\tau_{v1}^2 + \tau_{v2}^2))^{1/2} = 117,85$ MPa
 $\sigma_{t2} = f_u / (\gamma_{M0} \cdot \gamma_{M1}) = 576,00$ MPa
 $\sigma_{t3} = 0,9 \cdot f_u / \gamma_{M0} = 259,20$ MPa



Stresses on the overturned throat section

Verification as per alternative method in EN 1993 1-8:2005
 $\sigma_{t1} = \sigma_{t2} = N_{ax} / (n_w \cdot h \cdot a_w) = 83,33$ MPa
 $\tau_{v1} = 188,00$ MPa
 $\tau_{v2} = 235,00$ MPa
 $\sigma_{t1} = (\sigma_{t1}^2 + \tau_{v1}^2 + \tau_{v2}^2)^{1/2} = 83,33$ MPa
 $\sigma_{t2} = 83,33$ MPa



$\sigma_{t1} \leq \sigma_{t2}$ OK VERIFIED $S.F. = 4,89$, ratio* = 0,205
 $\sigma_{t2} \leq \sigma_{t3}$ OK VERIFIED $S.F. = 4,4$, ratio* = 0,227

$\sqrt{\sigma_{t1}^2 + \tau_{v1}^2 + \tau_{v2}^2} \leq f_{uL} \cdot \gamma_{M1}$ OK VERIFIED $S.F. = 2,26$, ratio* = 0,443
 $\sigma_{t2} \leq f_{uB} \cdot \gamma_{M2}$ OK VERIFIED $S.F. = 2,82$, ratio* = 0,355

Simplified method

Tension resistance of the welding:
 $F_{w,t} = f_{w,t} \cdot l \cdot (\sqrt{3} \cdot \gamma_{M0} \cdot \gamma_{M1}) = 332,55$ MPa
 $F_{w,t} = a_w \cdot h \cdot f_{w,t} \cdot \gamma_{M0} = 199,53$ kN
 $F_{w,t} \geq N_{ax}$ OK VERIFIED $S.F. = 3,99$, ratio* = 0,251

(*) additional safety factor with respect to the S.F. already considered above in the load (N_{ax})

Welding verification (type 2, full penetration)

Verification as per method of Eurocode 3 EN 1993 1-8:2005

Joint resistance is equal to the weakest material component

Data
Lug plate thickness, $t = 20,00$ (mm)
Welding length, $h = 60,00$ (mm)
dimension c ($c \leq 3$ mm) 3 (mm)
Known values
Welding side, $t1 = 8$ (mm)
Welding height, $h1 = 10$ (mm)
Welding throat, $a1 = 12,81$ (mm)
Welding angle 1, $\alpha1 = 51,34$ (deg)
Welding side, $t2 = 9,00$ (mm)
Welding height, $h2 = 10$ (mm)
Welding throat, $a2 = 13,45$ (mm)
Welding angle 2, $\alpha2 = 48,01$ (deg)

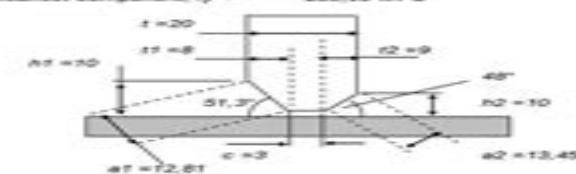
$a1 + a2 \geq t$ OK VERIFIED

Tension resistance of the welding:
 $F_{w,t} = h \cdot t \cdot f_y = 282,00$ kN
 $F_{w,t} \geq N_{ax}$ OK VERIFIED $S.F. = 5,64$, ratio* = 0,177

Materials

Yield of the lug, $f_{yL} = 235,00$ MPa
Yield of bottom beam, $f_{yB} = 355,00$ MPa
Yield of the weakest component, $f_y = 235,00$ MPa

Load
Load, $N_{ax} = P \cdot S.F. = 50,00$ kN



(*) additional safety factor with respect to the S.F. already considered above in the load (N_{ax})

Lifting Lug Design Manual

Lei Shi

A red circular graphic with a gradient, appearing as a stylized arrow or a decorative element, positioned to the right of the author's name.

Lifting Lug Design Manual:

Pressure Vessel Design Manual Dennis R. Moss, 2004-01-24 A pressure vessel is a container that holds a liquid vapor or gas at a different pressure other than atmospheric pressure at the same elevation More specifically in this instance a pressure vessel is used to distill crack crude material taken from the ground petroleum etc and output a finer quality product that will eventually become gas plastics etc This book is an accumulation of design procedures methods techniques formulations and data for use in the design of pressure vessels their respective parts and equipment The book has broad applications to chemical civil and petroleum engineers who construct install or operate process facilities and would also be an invaluable tool for those who inspect the manufacturing of pressure vessels or review designs ASME standards and guidelines such as the method for determining the Minimum Design Metal Temperature are impenetrable and expensive avoid both problems with this expert guide Visual aids walk the designer through the multifaceted stages of analysis and design Includes the latest procedures to use as tools in solving design issues

Design and Installation Manual for Thermal Energy Storage ,1980

Pressure Vessel and Stacks Field Repair Manual Keith Escoe, 2011-04-08 Written from the practitioner s perspective this book is designed as a companion for engineers who are working in the field and faced with various problems related to pressure vessels and stacks such as modification retrofitting existing pressure vessels or stacks to either enhance process capability lift move or replace damaged equipment This makes the book a valuable guide for new engineers who need to develop a feel for these types of operations or more experienced engineers who wish to acquire more useful tips this handy manual provides the readers with rules of thumbs and tips to mitigate or remediate problems which can occur on a daily bases Because of their size complexity or hazardous contents pressure vessels and stacks require the highest level of expertise in determining their fitness for service after these operations Care must be taken in installation removal of the vessel to avoid damage to the shell Damage to the shell can result in catastrophic failure and possible injury to personnel The book will cover topics such as lifting and tailing devices an overview of rigging equipment safety consideration inspection and repair tips methods to avoid dynamic resonance in pressure vessels and stacks wind loads and how to apply them for various applications and assessment guidelines for column internals tables and pressure vessel calculations and code formulas The examples in the book are actual field applications based on 40 years of experience from various parts of the world and are written from a view to enhance field operations In many parts of the world often in remote locations these methods were applied to repair pressure vessels and stacks These problems will still continue to happen so there is a need to know how to address them This book is to present assessments and techniques and methods for the repair of pressure vessels and stacks for field applications Also the book is to be a repair manual for easy use for mechanical engineers civil structural engineers plant operators maintenance engineers plant engineers and inspectors materials specialists consultants and academicians Lifting and tailing devices An overview of rigging equipment Inspection and repair tips Guidelines for

column internals Tables and pressure vessel calculations and code formulas Active Solar Energy System Design Practice Manual, 1979 **Federal Register**, 1979-05 **Materials Handling Handbook** Raymond A. Kulweic, 1991-01-16

Sponsored jointly by the American Society of Mechanical Engineers and International Material Management Society this single source reference is designed to meet today's need for updated technical information on planning installing and operating materials handling systems It not only classifies and describes the standard types of materials handling equipment but also analyzes the engineering specifications and compares the operating capabilities of each type Over one hundred professionals in various areas of materials handling present efficient methods procedures and systems that have significantly reduced both manufacturing and distribution costs Design for Production Manual. Volume III - the Application of Production Engineering. Final Report, 1985 **Multi-disciplinary Sustainable Engineering: Current and Future Trends** P.N. Tekwani, M. Bhavsar, B.A. Modi, 2016-05-17 The Nirma University International Conference on Engineering

NUiCONE is a flagship event of the Institute of Technology Nirma University Ahmedabad NUiCONE 2015 is focussed on events themes in the current trends in Engineering and its research issues Practicing engineers technologists and technopreneurs from the industry nbs Manual ... United States. Navy Department. Bureau of Ships, 1943 **Codes and Standards and Applications for Design and Analysis of Pressure Vessel and Piping Components, 1991** Robert F. Sammataro, 1991 **Proceedings of China Modern Logistics Engineering** Logistics Engineering Institution, 2014-10-11

Proceedings of China Modern Logistics Engineering covers nearly all areas of logistics engineering technology focusing on the latest findings and the following theoretical aspects Logistics Systems and Management Research Green Logistics and Emergency Logistics Enterprise Logistics Material Handling Warehousing Technology Research Supply Chain Management Logistics Equipment Logistics Packaging Technology Third party Logistics etc The book will help readers to grasp the relevant aspects of the theory involved research and development trends while also offering guidance for their work and related studies It is intended for researchers scholars and graduate students in logistics management logistics engineering transportation business administration E commerce and industrial engineering *Technical Record of Design and Construction* United States. Bureau of Reclamation, 1970 **Special Publication** IEEE Power Engineering Society, 1976

Coast Artillery Field Manual, 1938 **The Comprehensive Valve Dictionary** Karan Sotoodeh, 2025-09-10 This book is a pioneering reference work designed to address the complex terminology technical specifications and diverse applications of valves in industrial systems The Comprehensive Valve Dictionary is an authoritative and practical reference that demystifies the technical language surrounding industrial valves The dictionary provides detailed definitions of over a thousand valve related terms including valve types components materials standards testing methods and failure mechanisms In addition to traditional applications this dictionary places significant emphasis on valves used in renewable energy systems including those for hydrogen production hydropower carbon capture and storage CCS geothermal energy and wind power Moreover it

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High-performance Sustainable Materials and Structures Prince Lazar,I. A. Palani,Manish Kumar,2024-10-31 This book underscores the idea of harnessing the sustainable designs and materials in nature and integrating them into the field of engineering to design innovative materials and structures with multifunctional properties targeting defense automotive aerospace electronics nuclear healthcare energy sports packaging etc to offer improved safety reliability performance durability sustainability and functionality The concept of sustainability involves the understanding of how nature has evolved solutions to various challenges over millions of years and applying these principles to design innovative materials and structures with multifunctional properties This book provides a thorough examination of the methods and techniques used in developing sustainable materials and structures highlighting their potential for multifunctional applications The book delves into the expansion of our understanding in this field which is accompanied by novel synthesis and processing methods These methods and techniques incorporate sustainable strategies to create innovative materials and systems to offer a wide range of properties and functions making them highly attractive for various applications in different fields of advanced technology In addition these materials and structures can be tailored to have specific properties and functions such as self healing capabilities high strength to weight ratios and enhanced energy absorption which are the prime requirements for the researchers looking for lightweight materials and structures

Measuring and Developing Professional Competences in COMET Felix Rauner,2021-08-27 This book is a detailed manual for the implementation of competence diagnostics in the field of vocational training With the COMET competence model both conceptual competences as well as practical skills are recorded and evaluated The manual guides through all methodological steps including the preparation and implementation of tests cross and longitudinal studies the development of context analyses and measurement methods for the test motivation The focus of the final chapter is the application of the COMET procedure for the design organisation and evaluation of vocational education and training processes

Nuclear Power IEEE Power Engineering Society,1976 *Aeronautical Engineering* ,1985 A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in Scientific and technical aerospace reports STAR and International aerospace abstracts IAA

Technical Information Indexes United States. Naval Air Systems Command,1976

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