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Design considerations for the aluminium products

Alcoa Innovation

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Presentation Content

- Introduction
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- General Rules for the Design of Extruded Aluminium
- Corrosion Resistance
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- Conclusions

Introduction

Advantage of Aluminium from manufacturing standpoint :



- High resistance to corrosion
- High recycle ability
- ➢ High thermal conductivity
- Ease of deformation
- Comparatively low melting temperature

✓ <u>Aluminium products need some special considerations in design to give acceptable results.</u>

Aluminium

Applicable Welding methods for Aluminium

Linear welding methods: MIG, TIG, Laser, Friction stir welding, Plasma.

Local (point) welding methods: Spot welding, Resistance welding and Friction stir. welding*.

*: **Ref.**: Michel Guillot, Introduction à la conception de produits et de structures en aluminium, Réseau des ingénieurs du Québec, 2012 ALCOA: innovation

Effect of Various Loading on the Strength of Assembled Aluminium*



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[*] Aluminum design manual, The Aluminum association, 2006.

 $N = 5X10^{5}$

Bonding

Advantages:

- Reduction of noise and vibration
- Reduction of galvanic corrosion (e.g. aluminium and steel)
- Its capacity to joint dissimilar materials (e.g. aluminium and plastic)
- Assembly cost that is often lower compared to other techniques*

* Ref: M.Guillot, I.Bouchard, Effect of different adhesives on strength, energy absorption, and damping properties of bonded aluminium structures for the transportation industries, Conference Cansmart 2009, Int. workshop, Montréal, October 2009.

Bonding

You have to redesign your product to be appropriate for bonding.

- \checkmark Design to place bonding in shear not peel.
- \checkmark To reduce stress concentration, try to use ductile adhesive
- ✓ Recognize environmental limitations of adhesives and surface preparation

✓ Where possible bond to multiple surfaces to offer support to loads in any direction.

Bonding

Design consideration in bonding*



General rules to be respected:

Symmetry Rule: Symmetry provides more balanced forces and helps avoid overstressing areas of the die.



a)



*Ref.:www.thelibraryofmanufacturing.com

Eliminate hollow space as possible:







b)

> Try to use even thickness:





b)

Avoid sharp transition between thicknesses



➤Avoid sharp edges





b)







Minimize the number of closed cavities



Redesign of profile to reduce number of open cavities



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*Guide de solutions pratiques permettant de contrer la corrosion galvanique entre l'aluminium et l'acier dans le

Corrosion Resistance

Pitting

Why?

It occurs only in the presence of an electrolyte (either water or moisture) containing dissolved salts, usually chlorides).

Example of Solutions





Dump truck body

The main objectives of the project:

- 1) Reducing 450Kg of weight
- 2) Reducing number of parts
- 3) Removing long parts produced by bending (6 meters of length)
- 4) Reducing number of welding in the dump truck



Dump truck body

The new concept features:

- 1) 30 parts less
- 2) 500 Kg lighter
- 3) Doesn't need bending of 6 meters
- 4) 125 meters less welding

Final concept with less labor work and less part.

Initial concept with

5 components





Prototype of the New Dump Truck

(Courtesy of Soudure Brault Inc.)

Suspension chassis

The main objectives of this project were:

- 1) To convert the suspension chassis from steel to aluminium
- 2) To reduce 25% of the suspension chassis
- 3) To increase rigidity
- 4) To remove necessity of painting



Suspension chassis (Courtesy of REMTEC inc.)

Determination of real load cases by installation of some strain gauges and accelerometers.

Development of finite element model for both steel and Aluminium chassis.

Cycling testing of the fabricated prototype.



Finite element model of the chassis











Conclusion

- 1) Aluminium as an appropriate replacement for steel should be applied wisely or else the results can be disappointing .
- 2) In the design step, if the manufacturing points don't be considered the chance of product to be economic will be reduced tremendously.