

1. DergiPark
2. International Journal of Automotive Science and Technology
3. ArÅ ÅYiv
4. Cilt 1, SayÅ,,Å± 2

YÅ,,Å±l 2017, Cilt 1, SayÅ,,Å± 2, Sayfalar 1 - 7 2017-08-30

Zotero | Mendeley | EndNote | BibTex | Kaynak GÅfÅ¶ste

Investigation of the Effect of Corrugated Structure on Crashing Performance in Thin-Walled Circular Crash Boxes (420)

INVESTIGATION OF THE EFFECT OF CORRUGATED STRUCTURE ON CRASHING PERFORMANCE IN THIN-WALLED CIRCULAR TUBES

İbrahim Altın^[1], Serdar Halis^[2], Hâşim Serdar Yâşar

272 422

Abstract

Crash boxes are fasteners that are used in automobiles and have the ability to absorb energy emerged during impact. These parts can have different geometric properties. Within the scope of this study, corrugations of 1 mm, 3 mm, 5 mm in diameter were formed on the crash boxes. They are designed to have 0°, 2° and 4° taper angles. Each crash box has a wall thickness of 2 mm. The crash boxes designed were subjected to a velocity of 17 m/s with a mass deformation of 500 kg and crashing performances were investigated. As a result, the corrugation size was found to have influence on crashworthiness performance.

Anahtar Kelimeler

Corrugated, Thin-walled tubes, Finite element method, Specific energy absorption, Crush force efficiency

Kaynakça

- Jusuf, A., Dirgantara, T., Gunawan, L. and Putra, I. S.,
“Crashworthiness analysis of multi-cell prismatic structures”, International Journal of Impact Engineering, 2015, 78:34-50.
- Kashani, M. H., Alavijeh, H. S., Akbarshahi, H. and Shakeri, M.,
“Bitubular square tubes with different arrangements under quasi-static axial compression loading”, Materials and Design, 2013, 51:1095-11030.
- Zhang, Z., Liu, S. and Tang, Z., “Crashworthiness investigation of kagome honeycomb sandwich cylindrical column under axial crushing loads”, Thin-Walled Structures, 2010, 48:9-18.
- Zhang, X. and Zhang, H., “Experimental and numerical investigation on crush resistance of polygonal columns and angle elements”, Thin-Walled Structures, 2012, 57:25-36.
- Mamalis, A. G., Manolakos, D. E., Ioannidis, M. B., Kostazos, P. K. and Hassiotis, G., “Finite element simulation of the axial collapse of thin-wall square frusta”, International Journal of Crashworthiness, 2010, 6:2, 155-164.
- Nagel, G. M. and Thambiratnam, D. P., “Computer simulation and energy absorption of tapered thin-walled rectangular tubes”, Thin-Walled Structures, 2005, 43:1225-1242.

-
- Rezvani, M. J. and Nouri, M. D., "Analytical Model for Energy Absorption and Plastic Collapse of Thin-Walled Grooved Frusta Tubes", *Mechanics of Advanced Materials and Structures*, 2015, 22:5, 338-348.
 - Zhang, X., Zhang, H. and Wen, Z., "Axial crushing of tapered circular tubes with graded thickness", *International Journal of Mechanical Sciences*, 2015, 92:12-23.
 - Salehghaffari, S., Tajdari, M., Panahi, M. and Mokhtarnezhad, F., "Attempts to improve energy absorption characteristics of circular metal tubes subjected to axial loading", *Thin-Walled Structures*, 2010, 48:379-390.
 - Nia, A. A. and Parsapour, M., "An investigation on the energy absorption characteristics of multi-cell square tubes", *Thin-Walled Structures*, 2013, 68:26-34.
 - Song, J. and Guo, F., "A comparative study on the windowed and multi-cell square tubes under axial and oblique loading", *Thin-Walled Structures*, 2013, 66:9-14.
 - Tang, Z., Liu, S. and Zhang, Z., "Analysis of energy absorption characteristics of cylindrical multi-cell columns", *Thin-Walled Structures*, 2013, 62:75-84.
 - Chen, D. H. and Ozaki, S., "Numerical study of axially crushed cylindrical tubes with corrugated surface", *Thin-Walled Structures*, 2009, 47:1387-1396.
 - Kılıç, A. and Şaşlan, C., "Numerical crushing analysis of aluminum foam-filled corrugated single- and double-circular tubes subjected to axial impact loading", *Thin-Walled Structures*, 2015, 96:82-94.
 - Ghasemnejad, H., Hadavinia, H., Marchant, D. and Aboutorabi, A., "Energy absorption of thin-walled corrugated crash box in axial crushing", *Structural Durability and Health Monitoring*, 2009, 98:1, 1-17.
 - Eyvazian, A., Habibi, M. K., Hamouda, A. M. and Hedayati, R., "Axial crushing behavior and energy absorption efficiency of corrugated tubes", *Materials and Design*, 2014, 54:1028-1038.
 - Jin, S. Y. and Altenhof, W., "Comparison of the load/displacement

and energy absorption performance of round and square AA6061-T6 extrusions under a cutting deformation mode”•, International Journal of Crashworthiness, 2007, 12:3, 265-278.

- Wang, B. and Lu, G., ”Mushrooming of circular tubes under dynamic axial loading”•, Thin-Walled Structures, 2002, 40:167”•82.
- Attia, M. S., Meguid, S. A. and Nouraei, H., ”Nonlinear finite element analysis of the crush behaviour of functionally graded foam-filled columns”•, Finite Elements in Analysis and Design, 2012, 61:50-59.
- [20] Bi, J., Fang, H., Wang, Q. and Ren, X., ”Modeling and optimization of foam-filled thin-walled columns for crashworthiness designs”•, Finite Elements in Analysis and Design, 2010, 46:698-709.
- Djamaluddin, F., Abdullah, S., Ariffin, A. K. and Nopiah, Z. M., ”Multi objective optimization of foam-filled circular tubes for quasi-static and dynamic responses”•, Latin American Journal of Solids and Structures, 2014, 12:1126-1143.
- Gao, Q., Wang, L., Wang, Y. and Wang, C., ”Crushing analysis and multi objective crashworthiness optimization of foam-filled ellipse tubes under oblique impact loading”•, Thin-Walled Structures, 2016, 100:105-112.
- Goel, M. D., ”Deformation, energy absorption and crushing behavior of single-, double- and multi-wall foam filled square and circular tubes”•, Thin-Walled Structures, 2015, 90:1-11.
- Hou, S., Han, X., Sun, G., Long, S., Li, W., Yang, X. and Li, Q., ”Multiobjective optimization for tapered circular tubes”•, Thin-Walled Structures, 2011, 49:855-863.
- Aktay, L., Toksoy, A. K. and GÃ¼den, M., ”Quasi-static axial crushing of extruded polystyrene foam-filled thin-walled aluminum tubes: Experimental and numerical analysis”•, Materials and Design, 2006, 27:556-565.
- Ghamarian, A., Zarei, H. R. and Abadi, M. T., ”Experimental and numerical crashworthiness investigation of empty and foam-filled end-capped conical tubes”•, Thin-Walled Structures, 2011, 49:1312-1319.

- Hong, W., Fan, H., Xia, Z., Jin, F. and Zhou, Q., "Axial crushing behaviors of multi-cell tubes with triangular lattices", *International Journal of Impact Engineering*, 2014, 63:106-117.
- Abdewi, E. F., Sulaiman, S., Hamouda, A. M. S. and Mahdi, E., "Quasi-static axial and lateral crushing of radial corrugated composite tubes", *Thin-Walled Structures*, 2008, 46:320-332.
- Elgalai, A. M., Mahdi, E., Hamouda, A. M. S. and Sahari, B. S., "Crushing response of composite corrugated tubes to quasi-static axial loading", *Composite Structures*, 2004, 66:665-671.
- [30] Mahdi, E., Hamouda, A. M. S., Sahari, B. B. and Khalid, Y. A., "Experimental quasi-static axial crushing of cone-tube-cone composite system", *Composites Part B: Engineering*, 2003, 34:285-302.
- Acar, E., Guler, M. A., Gerçek, B., Cerit, M. E. and Bayram B., "Multi-objective crashworthiness optimization of tapered thin-walled tubes with axisymmetric indentations", *Thin-Walled Structures*, 2011, 49:94-105.
- Hosseini-pour, S. J. and Daneshi, G. H., "Energy absorption and mean crushing load of thin-walled grooved tubes under axial compression", *Thin-Walled Structures*, 2003, 41:31-46.
- Mokhtarnezhad, F., Salehghaffari, S. and Tajdari, M., "Improving the crashworthiness characteristics of cylindrical tubes subjected to axial compression by cutting wide grooves from their outer surface", *International Journal of Crashworthiness*, 2009, 14:6, 601-611.
- Rezvani, M. J. and Nouri, M. D., "Axial crumpling of aluminum frusta tubes with induced axisymmetric folding patterns", *Arabian Journal for Science and Engineering*, 2014, 39:2179-2190.
- Wei, Y., Yang, Z., Yan, H., Guo, Y., Wu, X. and Huang, C., "Proactive regulation of axial crushing behavior of thin-walled circular tube by gradient grooves", *International Journal of Mechanical Sciences*, 2016, 108-109:49-60.
- Wu, S., Li, G., Sun, G., Wu, X. and Li, Q., "Crashworthiness analysis and optimization of sinusoidal corrugation tube", *Thin-Walled Structures*, 2016, 105:121-134.
- Yang, Z., Yu, Y., Wei, Y. and Huang, C., "Crushing behavior of a

thin-walled circular tube with internal gradient grooves fabricated by SLM 3D printing

- Zhang, X. and Huh, H., Energy absorption of longitudinally grooved square tubes under axial compression, Thin-Walled Structures, 2009, 47:1469-1477.
- Qi, C. and Yang, S., Crashworthiness and lightweight optimisation of thin-walled conical tubes subjected to an oblique impact, International Journal of Crashworthiness, 2014, 19:4, 334-351.

Ayrıntılar

Konular

Dergi Bölümü

Yazarlar

Mühendislik, Makine

Volumes