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STUDY ON LARGE LAUNCH VEHICLE SEGMENTS CONNECTED BY BOLTS

Abstract

China currently is developing a new generation of carrier rockets ,the body diameter will reach 5m, its structure, layout, strength, stiffness characteristics and load conditions have a large difference with previous ripe models of launch vehicles, the stiffness of the segment and strength characteristics should be put forward to higher requirements , so we should take the connection characteristics and specific way to further explore. In this paper, first we analyze and experiment on single bolt with preload and have found out the effective range, then we analyze the difference of stiffness when the size and number of bolt have been changed, and give out the most effective connected mode for new carrier rockets. The main contents are as follows : 1, Using the cooling method to simulate the preload of bolt, then take the bolt to finite element modeling analysis, could conclude the stress distribution form and effective range. 2, Design experiment to analyze the affect range of the bolt with preload, including electrical measurement experiment and light elastic experiment, and verify the finite the results of element analysis. 3, Use the results of single bolt connection analysis to design the connection mode of a rocket and use the finite element modeling to analyse, get out the influence of joint stiffness with different specifications and number of bolts, provides reference for connection model designing of large section of the carrier rocket. Keywords ; strength and stiffness, connection mode, cooling method , preload, finite element modeling , experiment References; [1] LI Daokui, Engineering Mechanics [M], Beijing: Science Press, 2010 [2] NANGONG Baijun, Zhang Duo. Contacts between the launch vehicle separation surface-level analysis. Northwestern Polytechnical University, 2002,18 (3) 466-468 [3] GUANG Fengcheng, Chu Mei, Raymond Y.Y.Lee. Nonlinear vibration of a cantilever beam with tip mass under random base excitation[J]. American Institute of Aeronautics and Astronautics .2001,16(19):1-8 [4] Matthew Oldfield,Huajiang Ouyang,John E.Mottershead.Simplified models of bolted joints under harmonic loading[J]. Computers and Structures. 2005,84:25–33 [5] Kim J,Yoon JC,Kang BS.Finite element analysis and modeling of structure with bolted joints[J].Applied Mathematical Modeling, 2007,31(5):895-911 [6] John D.Reid,Nicholas R.hiser.Detailed modeling of bolted joints with skippage. Finite elements in Analysis and Design,2005(41): 547-562 [7] S.J.bullock,L.D.Peterson. Identification of nonlinear micron-level mechanics for a precision deployable joint[J].American Institute of Aeronautics and Astronautics.87-97