BLENDED WING BODY- A REVIEW

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Abstract- This paper explores the interior structure design of multi-shell blended wing body and investigates the optimum buckling strength of BWB. The interior structure includes floor, wall and frame of BWB.In this paper two relevant structural ~~design aspects are considered~~. First, modeling and statical buckling analysis of blended wing body of Isotropic metals. Second, modeling and statical buckling analysis of blended wing body of composite materials. Optimum solution with respect of material selection in blended wing body is reported.

Keywords: - blended wing body, multi bubble fuselage, Iso tropic metal, composite material.

1. Introduction

The concept of blended wing body was introduced almost 31 year ago. The idea was to build new type aircraft that would allow aircraft to carry more passengers. The Blended wing body is not fully novel concept because it was considered by Horten, Northrop and other from the mid of 1930 to the mid-1950s. BWB aircraft was previously called tailless airplane and flying wing aircraft [1, 2].After that BWB reintroduce by Robert Liebeck [3] at the McDonnell Douglas Corporation in 1988.Aeronautics Research Centre Niedersachsen (NFL) in Germany initiate a project Energy System Transformation in Aviation. The aim of the project is to reduce carbon di oxide emission with the help of new design concept and new technologies. After taking their project aim into consideration they come up with BWB which is most promising technology. BWB aircraft are a concept promising advantages in aerodynamic performance and a reduction of fuel consumption.Aircraft primary load distribution of a conventional aircraft vs a BWB aircraft [5] (fig. 1).Research shows the potential of unconventional aircraft with respect to environmental concerns and noise pollution.

Develop the efficient structure concept and leave the constraint of cylindrical pressure vessel of conventional aircraft.Reduction of the maximal bending stress due to the better distribution of the aerodynamic loads compared to a conventional tube and wing aircraft[6,7] .A higher passenger acceptance of BWB cabins was also found [8]. The interior of fuselage must be design to resist the internal cabin pressure.

Thus to increase structural efficiency, several multi-bubble fuselageconcepts were developed. In previous BWB studies [9] effects of cabin shape and volume were investigated from a baseline configuration using an aerodynamic-based optimization scheme, but structural design with internal pressure or buckling issues were not addressed.The main aim of this project is to investigate the optimum buckling strength of a blended wing body.The first part of this paper present design of multi-bubble fuselage segment for a BWB and its interior cabin structure analysis by considering two Iso-tropic metals. Second part of this paper presentsan interior cabin structural analysis of BWB by considering two composite materials.

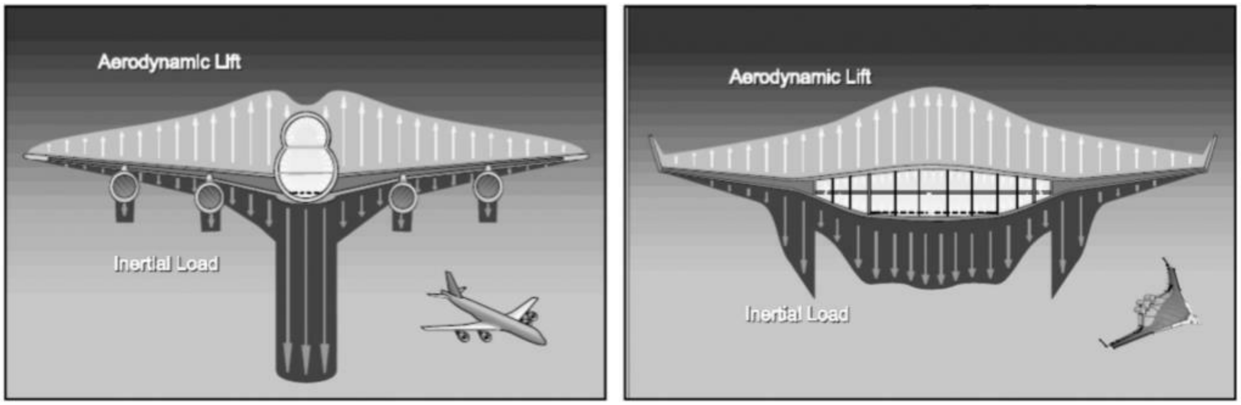

Fig 1:Aircraft primary load distribution of a conventional aircraft vs a BWB aircraft

Fig 2: a) Exterior view of NASA BWB.

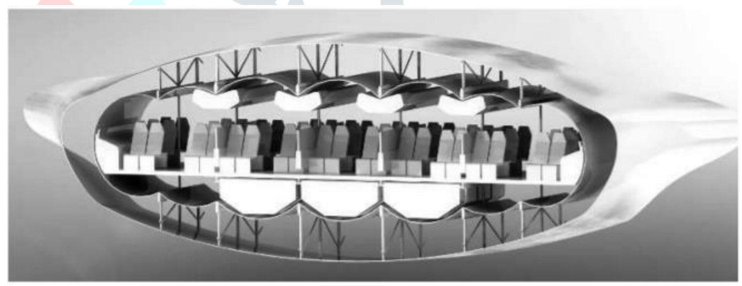

Fig 2: b) multi bubble fuselage cross section concept.

2. Literature review

RESEARCH PAPER	OBJECTIVE	CONCLUSION
1.EgbertTorenbeek(2016) Blended-Wing-Body Aircraft: A Historical Perspective.	This paper presents the Classical Airplane Concept,Flying Wing and Tailless Aircraft, Aerodynamic and Fuel Efficiency, Very Large Aircraft (VLA), Hybrid Flying Wing, Genesis of Blended Wing Body Aircraft, Development of the First-Generation BWB, Second-Generation BWB, Challenges and Advantages.	BWB study projects have proven that modern advanced design technologies are available to advanced designers tomake reliable predictions of essential BWB characteristics such as computational aerodynamics, structural analysis, and flying qualities.
2. Z.Van der voet, F.J.J.M.M Geuskens (2012), Configuration of the Multi-bubble Pressure Cabin in Blended Wing Body Aircraft.	This paper presents the interior concept and configuration for a BWB Aircraft with a capacity of circa 300 passengers.	In this case, the pressurization loads are carried by the multi-bubble only and all gravitational, inertia and aerodynamic loads are carried by the aerodynamic shell. The multi bubble BWB is more efficient when it comes to the transportation of passengers compared to a conventional aircraft. Overall it delivers similar comfort levels to the passengers.
3.V. Mukhopadhyay*(2005), Blended wing body fuselage structural design for weight reduction.	In this paper, Progresses towards recent 480 passenger version of BWB structural analysis are described. Use of rapid finite element analysis tools and results of several geometric configurations of the Y-braced fuselage derivatives are presented.	Configuration can be improved to a modified vaulted shell partial multi-bubble type fuselage which has better stress distribution, for same material and dimension.
4.VivekMukhopadhyay* (oct-1996) Structural Concepts Study of Non-circular Fuselage Configurations.	This paper Present the two non-circular pressure vessel concepts were selected for analysis: a) a flat sandwich shell concept and b) a vaulted sandwich shell concept, both with a honeycomb core. In this concept, the honeycomb was replaced by a double-skin shell with vertical span wise and chord wise rib stiffeners. Both the flat and vaulted double skin shell construction were analyzed and compared.	The results indicate that a double-skin vaulted ribbed shell concept could offer significant weight advantage over a flat ribbed shell concept as well as the both the honeycomb sandwich concepts with similar levels of stresses and deflections.

5. F.J.J.M.M Geuskens, O.KBergsma,S.koussios et al. Pressure vessel and Pressure cabin for blended wing body .	In this paper, established analytical methods to determine the stresses and deformations induced by pressure and focus on the practical aspects of integration of the pressure fuselage into the BWB.	The walls of the multi-cylinder and the tapered multi-cylinder are replaced by pillars .The walls in the multi-bubble are not carrying axial stresses, but only the vertical loads. A multi-bubble connected into an aerodynamic shell is a potential solution as a future pressure fuselage for Blended Wing Bodies.
6.V. Mukhopadhyay*, J.Sobieszczanski-sobieski et al. (2004) Analysis, Design, and Optimization of Non-cylindrical Fuselage for Blended-Wing-Body Vehicle.	This paper presents new sizing, analysis, design, and optimization results toward finding an efficient non-cylindrical BWB configuration, considering both internal pressure and compressive load including buckling stability.	A multi-bubble fuselage configuration concept was developed for balancing internal cabin pressure load efficiently through balanced membrane stress in inner cylindrical segment shells and interscabin walls. To provide buckling stability and carry spanwise bending loads, additional cross-ribbed outer shell structures appear to be quite effective. Thus, it was advantageous to use the inner cylindrical shells for pressure containment and let the outer shells resist overall bending.
7. Majeed bishara,peter horst et al. (2018) A structural design concept for a multi shell blended wing body with laminar flow control.	Static and fatigue analyses are presented for a new blended wing body (BWB) fuselage concept considering laminar flow control (LFC) by boundary layer suction in order to reduce the aerodynamic drag.	The changesin the skin layups do not have a major impact on the maximum stress, the change in frame and rib distances from 1 m to 0.5 m has reduced the maximal stress to 36% and the linear buckling analysis is increased from 0.82 to 1.26. The fatigue investigations did not indicate a clear advantage of a CFP micro-topology over a conventional interrupted fiber microstructure for the considered load situations.

8.Ravi Kumar , Ganesh Gupta, Shamili GK et al.(2017) Linear Buckling Analysis and Comparative Study of Unstiffened and Stiffened Composite Plate.	The present research was done a finite element analysis of stiffened and un-stiffened plates with three different types of composite materials have been carried out with a view to predicting the buckling load by software ANSYS 14.0 APDL	Over all analysis reveals that Kevlar yields highest strength and its deflection is the lowest.

3. Conclusion

The blended wing body shows the potential in reduction of fuel consumption, noise, stress and deformation. It also give high passenger acceptance .In the study BWB Effect of cabin shape and volume were investigate from baseline configuration but structural design with internal pressure or buckling issue were not deeply addressed .so material must be selected for interior cabin in order to have strength resistance ,heat resistance and high strength to weight ratio.

4. References

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