Case Report

ZSH-III Helmet in an Aircraft Accident A Case Report

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ABSTRACT

Cranio-facial injuries sustained by the pilot in a fatal aircraft accident were corroborated with deformities in a ZSH-III helmet. This revealed major design and manufacturing lacunae. ZSH-III helmet is used by aircrew operating MiG series of aircraft except Mig 29. Earlier laboratory trials of the same helmet had reported poor crash protection qualities. This case report analyses the design defects and poor crash worthiness of ZSH-III helmet, in light of earlier findings. Necessary recommnedations are made for providing adequate safety to the aircrew in a survivable accident.

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KEY WORDS: Aircraft accident; Helmet; Crash Worthiness; Survivable Accident.

Head injury is a common trauma among accident victims. In aviation, 14-20% fatalities are due to serious head injury [1]. In a survivable accident, it is vital that the helmet worn by the aircrew prevent head injuries. This is to enable him to escape from the crippled crashing aircraft.

This case report is presented to highlight deformations of a ZSH III helmet in an aircraft accident.

Case History

There was a fatal aircraft accident. The major injuries sustained by the pilot were of severe decelerative nature, primarily longitudinal, acting in transverse posterio-anterior (-Gx) direction.

The cranio-facial injuries were extensive. They included widespread fractures of skull and facial bones, lacerations at frontonasal and left fronto-temporal region. The injury pattern at the principal impact was evidently aggravated due to subsequent impacts.

The ZSH-III helmet worn by the pilot revealed severe uneven deformation of the bonedome. There was an inward anteroposterior deformation of about 7cm. This deformation inward led to an outward projection/coning to right temporal margin by about 4.2 cm. The helmet width had increased in the coronal plane by about 2cm and depth had increased by about 1.5cm. There were several depressions/dents localised mainly to the temporal and occipital region with depth varying from 0.2 to 0.6mm. The visor was found with broken hinged pieces on either side. The

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deformities of inner leather helmet and facemask were not significant.

Discussion

In a harnessed aircrew, there is no restraint mechanism for the freely mobile head. A helmet is required to modify the impact forces within the tolerable limits. ZSH-III helmet is widely used by aircrew operating MiG series of aircraft except MiG-29. This is a two piece helmet, with outer bonedome and inner leather helmet.

In the case under discussion, the location of the initial impact was at the frontal margin. This led to the deformation of the bonedome, suggesting poor distribution of the impact load by the helmet. Helmet shell is known to be inherently weak around the frontal margin. This in turn may lead to local concentration of the impact stress. The bonedome, instead of being strong and inflexible to prevent deformation to the skull and increasing the tolerance to linear acceleration, had deformed. This deformation of the helmet reflected poor shock absorption and impact load distribution.

In this accident, where excessive decelerative forces were not survivable, one need not discuss about the helmet. But the helmet in question, the ZSH-III helmet would provide poor quality of protection in a survivable accident. Hence it is pertinent to discuss about this helmet and its crash worthiness.

There are three main aspects for assessment of helmet design. These are - penetration resistance, shock absorption and helmet retention [1]. Based on these aspects, Verghese and Rai [2] evaluated ASH-III helmet were much below the international standard requirements, including the penetration resistance.

In another test report, Aravindakshan Sinha et al [3] reported that the top of the ZSH-III helmet caved in during the trial impact. However the helmet did not disintegrate. The helmet did not absorb the impact energy adequately. However, the penetration resistance was considered satisfactory.

A helmet is likely to protect the head if it absorbs shock in excess of 82% in survivable accident. Therefore an attenuation factor of 5.5 or more is essential. However ZSH III helmet had an attenuating of 385 attenuating only 74% of the impact energy[3]. Hence, it would not provide adequate protection to the head. In comparison, ABEU MK II helmet [3], Gueneau helmet of Mirage [4] and Jaguar flying helmet [5] were found satisfactory on evaluation.

Conclusion

A test report need not remain locked to gather dust but recommendations made be implemented to improve flight safety and safety of the aircrew. The case in point is that Verghese and Rai had reported in 1972[2] about the poor crashworthiness qualities of ZSH-III helmet. Despite of standing revelations during trial about poor crash worthiness qualities of ZSH-III helmet a large number of requirement that ZSH-III helmet be replaced with a crashworthy helmet. Moreover any acquired piece of protective flying clothing including helmets be thoroughly evaluated as per international design and manufacturing specifications.

There is also a felt need that recommendations of various courts of inquiry be viewed seriously, especially those pertaining to the safety of the aircrew or flight safety in general. To conclude one of the only three recommendations made in the case under discussion was that ZSH-III helmet used in all types of aircraft should be replaced with

crashworthy helmet to prevent fatality in a survivable accident.

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