

考慮翻覆安全之大客車骨架結構最佳化設計

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摘要

巴士是大眾運輸工具之重要一環，而巴士在翻覆意外中，上層結構(superstructure)會嚴重變形，且乘客及駕駛會承受重要的傷害。因此如何設計一輛巴士的上層建築，使巴士具有良好的勁度則為一極重要的工作。歐盟及美國均強力推動巴士翻覆的安全法規:歐規ECE R66(Regulation number 66 of the Economic Commission for Europe)及美國聯邦車輛安全法規FMVSS 220(Standard number 220 American Federal Motor Vehicle Safety Standards)。然而強化巴士上層結構卻會造成重量增加，因而在結構設計上考量輕量化亦為一重要的設計主題。因此，本論文首先研究歐規 ECE R66及美規 FMVSS 220在安全規範上之不同處；其次，在保持重量不變及強度水準不變的條件下，進行巴士上層結構的最佳化設計研究以減少乘客的損傷；最後，參考巴士骨架變形及存活空間的因素下來進行巴士結構輕量化的設計。本研究利用LS-DYNA的FEMB模組建構有限元素模型，其間並採用巴士上部連接處之處理乃採用車輛研究中心(ARTC)及車頂邊緣的連接處之實驗數據，並應用LS-DYNA971進行求解。經比較研究歐規ECE R66及美規FMVSS220發現歐規ECE R66巴士的側翻測試，對乘客艙及殘留空間之需求較為嚴格。此外，本論文進行簡化大客車骨架結構之最適化分析時，應用LS-OPT中的連續回應表面法(Successive Response Surface Method)進行最適化的研究，發現能量吸收能力為大客車骨架結構最適化的一個重要的影響因素。本論文以上之研究成果應可提供未來大客車上層結構設計之參考應用。

關鍵詞：大客車翻覆、上層結構、ECE R66、FMVSS 220、能量吸收、LS-DYNA、輕量化、最適化方法、LS-OPT

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