

# Abstract

Nowadays, many evacuation models exist in the market, and new models are continuously released with new features. How to assess the usability and reliability of model results becomes an issue for both developers and users. Therefore, verification and validation (V&V) protocols were introduced in the assessment process of evacuation models. To conduct V&V of a model, a widely accepted test procedure should be defined and followed by the tester. However, there are no comprehensive and globally accepted V&V test procedures available to conduct V&V of evacuation models. Therefore, the International Standard Organization Verification and Validation Standard (ISO V&V Standard) (ISO, 2019) was proposed as a new benchmark of V&V for building evacuation models. This ISO document (ISO, 2019) includes carefully designed V&V tests based on accepted knowledge of human behaviour in fire and building features. Notably, a most comprehensive validation test procedure is provided with a list of recommended experimental data for the first time, along with methods to conduct the model results evaluation. This thesis goes through the whole ISO V&V test procedure including a global validation test by applying it to a simulator named FDS+Evac (Korhonen, T., & Hostikka, 2009). The benefits of the application of the ISO test procedure in V&V were identified and discussed in comparison with existing test procedures. Based on the simulated results except test 26, the issues and challenges of FDS+Evac and current evacuation models were analysed and summarised. It should be noted that the ISO document referred in this thesis is undergoing modifications and is routinely updated by ISO; therefore, the thesis work can be used to provide possible suggestions for improvements to refine the ISO V&V Standard protocol.

# 摘要

如今，很多的人员疏散（撤离）模拟模型（软件）可供选择和使用。新的模型也在不断地进行研发并且具备新的功能。但是，如何对这些模型和软件就行实用性和可靠性的验证，是一个对开发者和测试者都具有的难题。因此，验证及确认（verification and validation）被提出并且用于对撤离模型的评估中。在进行验证及确认的过程中，一个被广泛接受的验证及确认流程应该被规定下来，测试者也应该遵循此流程。但是，现如今没有一个可被广泛接受和认可的测试流程能用于对撤离模型的验证及确认中。这是因为现有的验证及确认流程或多或少在实际应用中存在一些问题。因此，新的国际标准化组织起草的验证及确认标准（International Standard Organization Verification and Validation Standard）（ISO, 2019）被提出，并且作为新的对撤离模型的验证及确认流程的标准。在新的验证及确认标准中，包含有精心设计的验证及确认的测试实验。这些实验都是结合最新的人类行为学和建筑发展精心设计的。尤其是对确认部分（validation）的测试流程和实验数据来源的详细陈述，尚属首次。本文将用 FDS+Evac(Korhonen, T., & Hostikka, 2009) 软件对整个 ISO 验证及确认流程中的各个测试实验进行模拟。经过与现有的验证及确认流程的对比，使用 ISO 验证及确认流程的优势将被详细陈述。基于各个测试实验的结果，在模拟过程中发现的问题和将来面临的挑战将会分析和总结。由于本文使用的 ISO 文件尚处于最后的完善阶段，尚未发布，因此本文的一些结论可被用于对 ISO 测试流程的改进和完善。