中文摘要

近幾年數位工具廣泛應用於建築設計領域，尤其是 CAD/CAM 技術已經成為輔助建築設計與建造過程的重要新設計媒材。而且藉由 CAD/CAM 新媒材的輔助，得以建構複雜及多變化的自由形體建築設計。從 CAD/CAM 媒材當前發展可知，數位建構過程已在建築專業領域中應用於許多設計案，同時也開發出應用 CAD/CAM 輔助自由形體建築的設計與建造專業標準化系統，如 Gehry Technologies (GT), Smart geometry 等。另一方面，研究領域開始探討應用 CAD/CAM 媒材的過程與步驟，而這些研究也應用到教育領域，目前歐美知名建築系所已開設 CAD/CAM 相關的課程。

從上述可知，CAD/CAM 媒材已成為數位時代建築的關鍵性設計媒材。然而，大多數設計者對此新媒材應用並不熟悉，雖然已有如 GT 的 CAD/CAM 專業標準化系統，但這是一種必須基於進階技術及高經費環境下操作的系統，對於亞洲地區的既有環境執行上具有困難，因此，本研究希望可以在 GT 高技術門檻與我們現有設計環境的落差中找尋一種可執行的 CAD/CAM 設計與建造過程，並將之發展成教學應用。針對本論文研究的問題，提出三個研究目標：1. 整合一個可被應用及普遍化(generalizing)的「CAD/CAM 設計與建造的過程」。2. 了解 CAD/CAM 媒材的特性與功能，簡化 CAD/CAM 軟硬體設備的繁瑣步驟，提出標準操作準則的建議。3. 將所整合的 CAD/CAM 設計與建造過程，發展成教學應用的課程初期將學綱要建議。

本論文研究進行了三個研究步驟，首先以案例研究來分析國際與國內自由形體設計案，接著對於 CAD/CAM 過程中的煩瑣步驟進行技術研究，共有兩個子步驟：1.轉檔過程分析及 2.過程自動化。最後再將前面兩步驟的結果應用於兩種教學案例：1.CAD/CAM 設計過程及 2.CAD/CAM 設計與建造過程，再對此兩種課程進行討論。

研究結果，從案例研究中歸納出一個普遍可執行的先期「CAD/CAM 設計與建造過程」。透過技術研究，本論文研究提出應用不同 CAD/CAM 媒材(雷射切割、FDM 快速成型、3D 雷射掃瞄)的轉檔過程建議，並將過程中繁瑣的步驟簡化，撰寫骨架及折板表皮製作的部分自動化步驟。藉由分析討論兩種教學案例，本論文研究歸納出「CAD/CAM 設計過程」的教學綱要建議 及「CAD/CAM 設計與建造過程」的先期教學綱要建議。本論文研究在案例選擇、設備及軟體選擇、及教學案例的數量，目前都較具侷限。對於研究貢獻上則提供了容易被執行的簡化步驟及教學應用的課程綱要建議。後續研究希望整合更完整的過程及教學建議，並進一步探討應用 CAD/CAM 媒材的創造力與設計風格理論研究。

英文摘要

Digital design tools were applied to the architectural design field extensively in recent years, especially CAD/CAM technology has become important design media in aiding architectural design and construction process. From the current development, digital fabrication using CAD/CAM media has applied in a lot of free-form design cases of professional architectural field. Moreover, the professional standardized CAD/CAM system also developed for instance Gehry Technologies (GT), Smart geometry, etc. On the other hand, the research field begins to probe into the process and steps of using CAD/CAM media, and applied to the educational field further.

CAD/CAM media has become the crucial design media in architectural design in digital era. However, most designers are not familiar with this new media. Although there has the GT professional standardized system, but it must be operated based on the high-tech and high budgets. It has difficulty to implement in the environment of low-tech and low budgets in Asia. So, this research hopes to find out an executable CAD/CAM design and construction process in the drop of GT high-tech threshold and our existing design environment. Furthermore, apply the process to the educational application. This thesis has three objectives: 1. Integrate an executable generalizing CAD/CAM design and construction process. 2. Understand the characteristic of CAD/CAM media, simplify the tedious steps of CAD/CAM software and hardware equipment, and propose the suggestion of procedure criterion. 3. Apply the integrated CAD/CAM design and construction process to the application of education.

This thesis operates three steps of research methodologies. First, case study, second, technical study and last step educational cases. Research result, from the case study which analyzing the international and domestic free-form design cases, this thesis concludes a preliminary “CAD/CAM design and construction process”. Through technical study, this thesis proposes the suggestion of procedure criterion in using different CAD/CAM media (laser cutter, RP FDM, 3D laser scanner), simplify the tedious steps in operation of frame and skin design, and provide automation steps. Lastly, by analyzing and discussing two kinds of teaching cases, this thesis proposes a teaching course outline of “CAD/CAM design process”, and the preliminary teaching course outline of “CAD/CAM design and construction process”. The selection of the cases, the CAD/CAM equipment and software, and the amount of the teaching cases, are the limitations of this thesis. Further study hopes to improve and complete the process and the course outline, also probe into the creativity and style theory research in using CAD/CAM media.