PARAMETER BASED CONSTRUCTION

Technical Field

[0001] The present invention relates generally to the field of building construction and, in particular, to improving the efficiency in construction of buildings, ranging from relatively low complexity single storey buildings to high-rise skyscrapers. The present invention also relates to a method and apparatus for improving the efficiency in construction of buildings, and to a computer program product including a computer readable medium having recorded thereon a computer program for improving the efficiency in construction of buildings.

Background

[0002] A plethora of Building Information Modelling (BIM) software is presently available to assist architecture, engineering, and construction (AEC) professionals to plan, design, and construct buildings and infrastructure. However, present building construction methods still require significant adjustment on-site to make building modules fit and meet required specifications.

Summary

[0003] ~~It is an object~~Embodiments of the present invention seek to substantially overcome, or at least ameliorate, one or more disadvantages of existing arrangements.

[0004] Disclosed are arrangements, referred to as a Harmonised Parameter based Design for Manufacture and Assembly (HPDMI) arrangement, which seek to address the above problems by providing a cloud-based platform enabling participants across the construction space, from architects, through participants in all the requisite trades, building certifiers and the like to (A) access and populate an electronically accessible construction catalogue storing a hierarchical collection of parts, assemblies, master-assemblies and the like, which can be used as standardised elements in construction, (B) access industry approved 3rd party software platforms used to create, analyse and process such standardised elements, and (C) harmonise elements generated for and selected from the catalogue for a particular construction project to ensure that the generated and selected elements (i) substantially do not clash when they are used to construct the building, and (ii) when assembled to form the building satisfy attribute criteria specified in the input specification. In other words, the disclosed HPDMI arrangements enable building modules to be manufactured off-site and assembled on-site to form the desired building with significantly less on-site adjustment being required to make the building modules fit and meet specified attributes than is the case with present building construction methods.

[0005] According to a first aspect of the present disclosure, there is provided a computer implemented method of harmonised parameter based design of a building in facilitating construction~~ing a~~ of the building, the method comprising the steps of:

receiving an input specification for the building, said input specification specifying pre-harmonisation modules required to construct the building, said pre-harmonisation modules defined by respective pre-harmonisation module specifications comprising respective geometric parameters and respective attributes;

identifying which of the pre-harmonisation module specifications are stored in an electronically accessible database, said identified pre-harmonisation module specifications being referred to as first pre-harmonisation module specifications having associated geometric parameters and attributes which are stored in separate sections of the database;

harmonising the module specifications in the first pre-harmonisation module specifications to form a set of parametrised and harmonised module specifications which specify harmonised modules which (a) substantially do not clash when they are used to ~~construct~~ provide the building, and (b) when assembled to form the building satisfy attribute criteria specified in the input specification; and

facilitating construction~~ing~~ of the building using the harmonised module specification.

[0005a] According to another aspect of the present disclosure, there is provided a computer implemented method of harmonised parameter based design of a building in facilitating construction of the building, the method comprising the steps of:

receiving an input specification for the building, said input specification specifying pre-harmonisation modules required to provide the building, said pre-harmonisation modules defined by respective pre-harmonisation module specifications comprising respective geometric parameters and respective attributes;

identifying which of the pre-harmonisation module specifications are stored in an electronically accessible database, said identified pre-harmonisation module specifications being referred to as first pre-harmonisation module specifications having associated geometric parameters and attributes which are stored in separate sections of the database;

harmonising the module specifications in the first pre-harmonisation module specifications to form a set of parametrised and harmonised module specifications which specify harmonised modules which (a) substantially do not clash when they are used to provide the building, and (b) when assembled to form the building satisfy attribute criteria specified in the input specification;

facilitating construction of the building using the harmonised module specification; and

wherein prior to the harmonising step, the steps of:

generating pre-harmonisation module specifications which are not stored in the database, said generated module specifications being referred to as second pre-harmonisation module specifications;

wherein the first pre-harmonisation module specifications together with the second pre-harmonisation module specifications form a set of pre-harmonisation module specifications; and

wherein the harmonising step comprises harmonising the set of pre-harmonisation module specifications comprising the first pre-harmonisation specification modules together with the second pre-harmonisation module specifications.

[0005b] According to another aspect of aspect of the present disclosure, there is provided a computer implemented method of harmonised parameter based design of a building in facilitating construction of the building, the method comprising the steps of:

receiving an input specification for the building, said input specification specifying pre-harmonisation modules required to provide the building, said pre-harmonisation modules defined by respective pre-harmonisation module specifications comprising respective geometric parameters and respective attributes;

identifying which of the pre-harmonisation module specifications are stored in an electronically accessible database, said identified pre-harmonisation module specifications being referred to as first pre-harmonisation module specifications having associated geometric parameters and attributes which are stored in separate sections of the database;

harmonising the module specifications in the first pre-harmonisation module specifications to form a set of parametrised and harmonised module specifications which specify harmonised modules which (a) substantially do not clash when they are used to provide the building, and (b) when assembled to form the building satisfy attribute criteria specified in the input specification;

facilitating construction of the building using the harmonised module specification; .

wherein prior to the harmonising step, the steps of:

generating pre-harmonisation module specifications which are not stored in the database, said generated module specifications being referred to as second pre-harmonisation module specifications;

wherein the first pre-harmonisation module specifications together with the second pre-harmonisation module specifications form a set of pre-harmonisation module specifications; and

wherein the harmonising step comprises harmonising the set of pre-harmonisation module specifications comprising the first pre-harmonisation specification modules together with the second pre-harmonisation module specifications; and

wherein the harmonising step includes the steps of:

determining if analysis of one or more of a post clash-detection part, a post clash-detection assembly, or a post clash-detection master-assembly specification in question is required in order to establish if the attributes of the post clash-detection part, the post clash-

detection assembly, or the post clash-detection master-assembly specification in question satisfy the attribute criteria specified in the input specification;

if analysis of said one or more of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question is required:

assigning corresponding attributes to the one or more of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question;

performing corresponding one or more analysis processes, maintaining the geometry and attributes of said one or more of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question in separate sections of the database throughout the course of the analysis;

determining if the attributes of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question satisfy the attribute criteria specified in the input specification;

if the attributes of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question do not satisfy the attribute criteria specified in the input specification, determining if the assigned corresponding attributes or the geometric parameters of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question need to be adjusted;

if the geometric parameters are to be adjusted, adjusting the geometric parameters so that the attributes of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question satisfy the attribute criteria specified in the input specification; and

if the attributes are to be adjusted, adjusting the attributes of the post clash-detection part, the post clash-detection assembly, or the post clash-detection master-assembly specifications in question so that the attributes of the first pre-harmonisation module specifications satisfy the attribute criteria specified in the input specification.

[0005c] According to another aspect of the present disclosure, there is provided a data structure storing specification records each record specifying a pre-harmonisation module used for facilitating construction of a building, wherein:

each record specifies one of a part specification, an assembly specification, a master-assembly specification, and a building specification;

each record comprises respective geometric parameters and respective attributes for the stored specification;

memory allocated to each record comprises a section for storing the geometric parameters of the record and a section for storing attributes for the record; and

the geometric parameters and the attributes for each record are stored in the separate sections of the database to thereby reduce the computation time required for processing one or more specification records in the data structure to provide the building.

[0006] According to another aspect of the present disclosure, there is provided an apparatus for implementing any one of the aforementioned methods.

[0007] According to another aspect of the present disclosure, there is provided a computer program product including a computer readable medium having recorded thereon a computer program for implementing any one of the methods described above.

[0008] Other aspects are also disclosed.

Brief Description of the Drawings

[0009] Preferred embodiments of the present invention will now be described, by way of example only, with reference to the drawings, in which:

[0010] **Fig. 1** shows a functional block diagram for one example of the disclosed HPDMI arrangement;

[0011] **Figs. 2A** and **2B** form a schematic block diagram of a general-purpose computer system upon which HPDMI arrangements described can be practiced;

[0012] **Fig. 3** is an example flow chart for a part-based HPDMI harmonisation process;

[0013] **Fig. 4** is an example flow chart for an assembly-based HPDMI harmonisation process;

[0014] **Fig. 5** is an example flow chart for a master-assembly-based HPDMI harmonisation process;

[0015] **Fig. 6** shows an example flow chart for an HPDMI geometric parameter and attribute harmonisation process used in the processes of **Figs. 3, 4** and **5**;