PARAMETRIC MODELLING OF MODULAR VAULT ROOMS

M. Kolarević, Lj. Cvetković, R. Bošković

Abstract: *These papers show parametric modelling of vault rooms of „Modulprim" types which are based on modular structure. Suggested approach enables quick response at customer's specific demands, better product quality and reduction of manufacturing expenses. This approach increases efficiency of whole manufacturing system and its competitivness at market.*

Key words: *parametric modelling, modular design, vault room*

1. INTRODUCTION

A vault room is a place where we deposit our valuables, which are nowhere else secure enough. Today when we speak about quality of life security plays a crucial role. Security that can be seen, felt and experienced - the most important feature of vault rooms.

Constructing a vault room we must give precise attention to assuring long term reliability. In existing buildings we must find the most adequate solution and optimum grade of security.

A reason for construction of vault room is a number of valuables that should be protected. From the technical aspect a construction of a vault room must meet demands of future generations and assure highest level of security in spite of future improvements of burglary equipment.

Each vault room is a new product which should be necessarily adapted to available dimensions. For that reason we must repeat all phases of designing process. Classic method design with 2D modelling is slow and with a low-quality designing documentation.

The goal of these papers is to indicate the basic advantages of 3D parametric modelling of vault rooms of "Modulprim" types which are based on modular structure. Software Autodesk Inventor is used for these needs.

2. MODULAR VAULT ROOM

The vault room is a very complex engineering object with the next requirements:

- hight level of security of burglary equipment
- fire resistance
- radiation resistance
- flood control etc.

The users of vault room are:

- The banks for deposit of valuables: money, precious metals, security documents, valuables of their account holders in the cash boxes,
- The post offices for deposit of money and security documents,
- The gouvernment, administration, army and police for deposit of security documents, drafts etc.
- the industrial firms for deposit of security documents (patents, innovation ...), drafts etc.

All modules of vault rooms are manufactured in the Security Equipment factory and are transported on a construction site where a modular construction is composed of standardized units that can be easily and flexibly arranged.

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The final part of modular vault room is the vault door with different security grades, different types of locks and different types of day doors (optional day grill or glass door).

The furnishing of vault rooms is also customised:

- cash boxes (mechanical or electronic version)
- 24-Hours - system - always available cash boxes
- cabinets and racks.

The scheme of modular vault room with components is shown in figure 1.

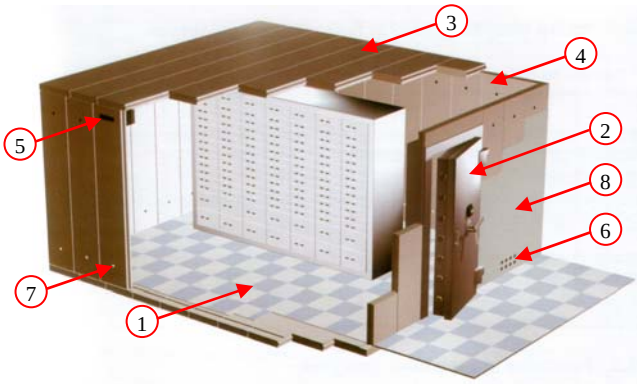

Figure 1: *Scheme of modular vault room*
1. Floor and ceiling components 2. Vault door 3. Construction components 4. Inner covering 5. Ventilation system 6. Airing 7. Cables 8. Outer coverings

The modular vault room is often rectangular because that configuration is simple for manufacturing and assembly. However rectangular configuration is not the only one.

The modular vault room with round sides and corners is undesirable and impractical but it is possible to realise configuration with more rectangulars.

All modules are assembled with welding. From statics view it is useful. The components of construction are estimated to carry their own weight and added load of 300 daN/m^2 to span 5,0 m between walls. This is significant when a vault room must be assembled in bank halls or office halls.

The height of a vault room i.e. the length of lamella is limited on 3,0 m because of standard machine tools.

The wall thickness of modular vault room is two or three times thinner than walls of massive vault room and the weight of modular vault room is smaller than massive vault room.

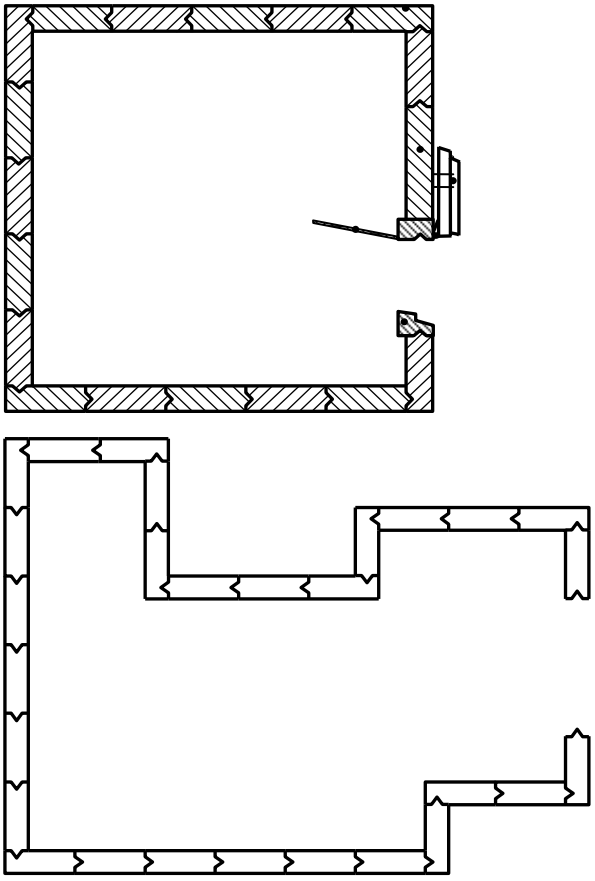

Figure 2: *Scheme of horizontal intersection of modular vault room*

Modular vault rooms have numerous advantages compared to massive construction of vault rooms. Basic advantages of a modular vault room are[1]:

- Thin walls enable high usability of space.
- Possibility of setting up vault room in upper floors of new buildings or rebuilding of existing rooms into vault rooms.
- Modulprim components are welded together and this makes the object compact. Theoretically, it is also possible to disassemble the object and transfer to another location.
- Short assembly time.

3. MODULAR STRUCTURE OF VAULT ROOM "MODULPRIM"

For representative of modular vault room "Modulprim" from company „Primat ad"- Maribor is selected the model "Modulprim 5" whose basic parameters are specificatied in the table 1.

Table 1. *Specification of vault room "Modulprim 5"*

Model		MODULPRIM 5
Security grade according to EN 1143 – 1		V / 270 RU
Wall thickness		100 [mm]
Weight / m^2		295 [kg]
Max. span (inner lights) at ceiling load	100 daN / m^2	6000 [mm]
	300 daN / m^2	5000 [mm]

The basic modules of vault room "Modulprim 5" are (Figure 3):

- Lamella type **A**,
- Lamella type **B**,
- Lamella type **C**,
- Lamella type **C***,
- Lamella type **D** and
- Lamella type **E.**

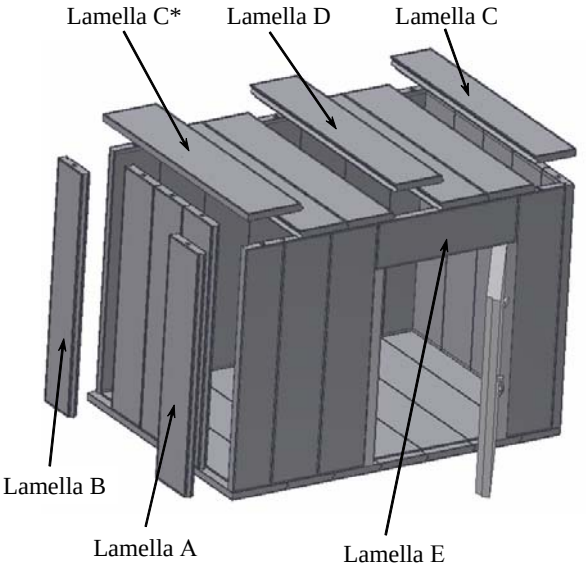

Figure 3: *Modular vault room "Modulprim 5" with construction components*

Structural scheme of "Module 1" i.e. "Lamella A" is presented in the figure 4. The other modules are with similar structural scheme. Number of components for forming the module is minimal. Hierarchial structure of modular vault room with components is illustrated in figure 5.

4. PARAMETRIC MODELLING OF BASIC MODULS OF VAULT ROOM "MODULPRIM"

The Parametric modelling is a method which uses CASE – *Computer Aided Softwer Engeneering* – tools for searching and making technical solutions and managing with dimensions for creating a geometric model of product. In the relation of traditional design this is a large progress because it is a possible to manage with "the design parametars" in every design phase. The values of paremeters are determined in the design process. However, the value of paremeters are possible to know on the start of the designing process.

For illustration of the parametric modelling a model of "lamella A" of a vault room "Modulprim 5", especially a cover plate, has been selected. The geometry of a cover plate of lamella A is defined across contours and constraints for all gamma of lamellas A. Process modelling of components of product is reduced only to defining the dimensions of geometric parametars of 3D model.

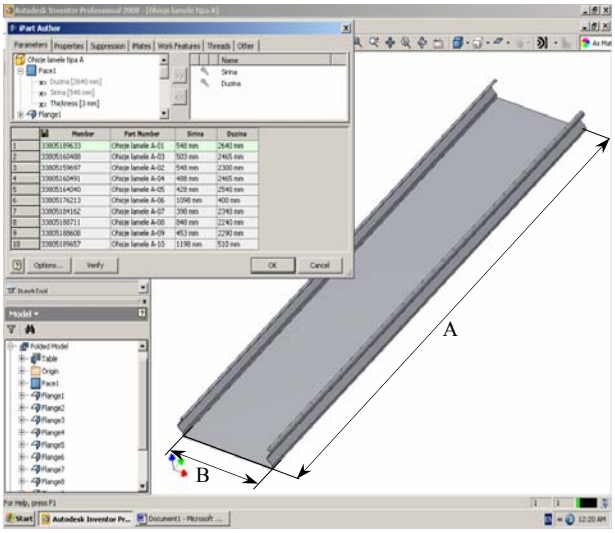

Figure 6: *Geometric model of steel cover plate of lamella type A with a table of parametars*

Drawings of modules and all components of a vault room are formed with a table of parametars (figure 7).

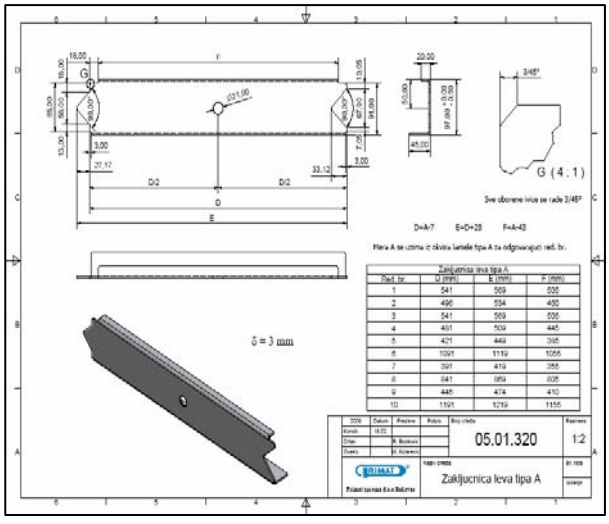

Figure 7: *Drawing of right cover with a table of parametars*

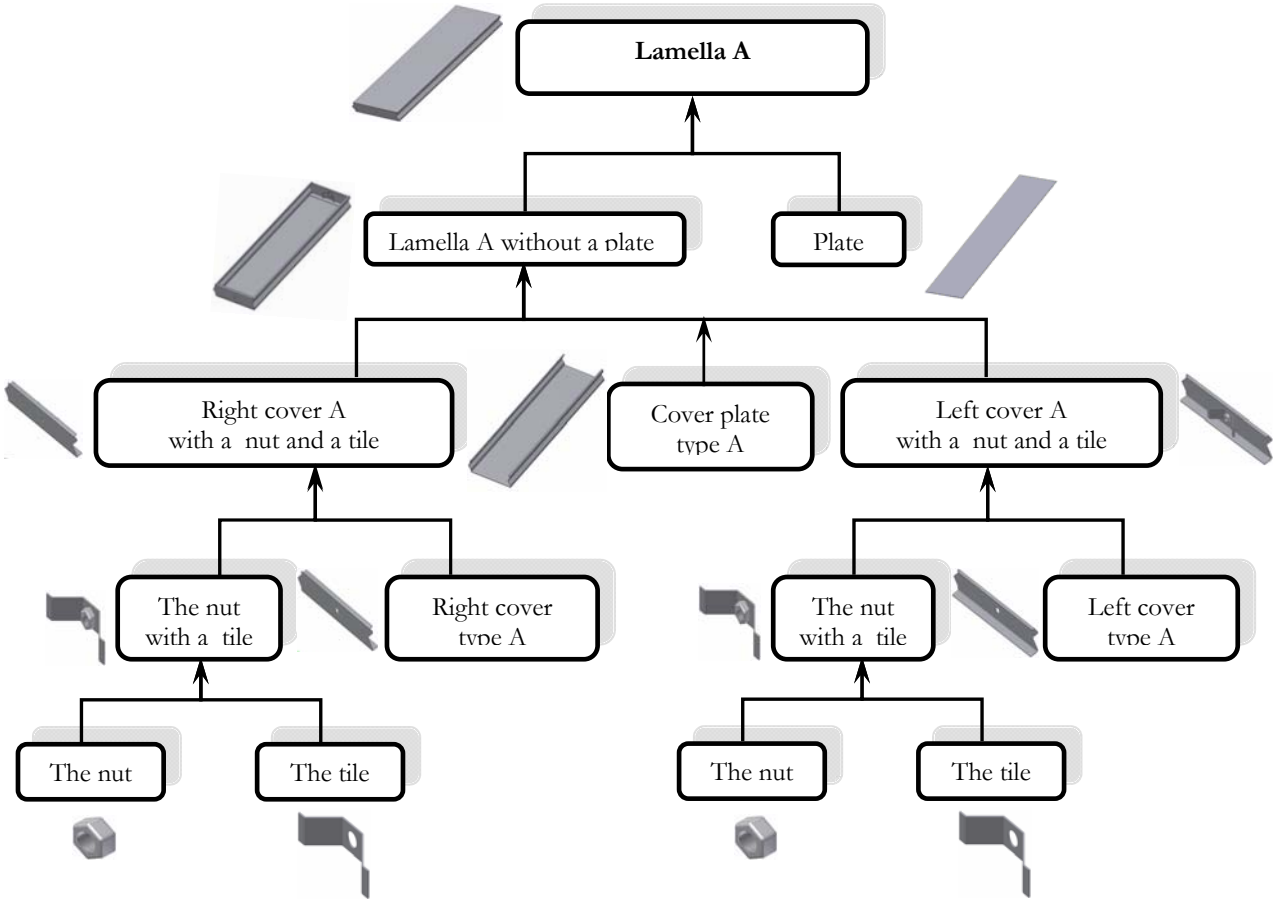

Figure 4: *Structural scheme of cover plate type A*

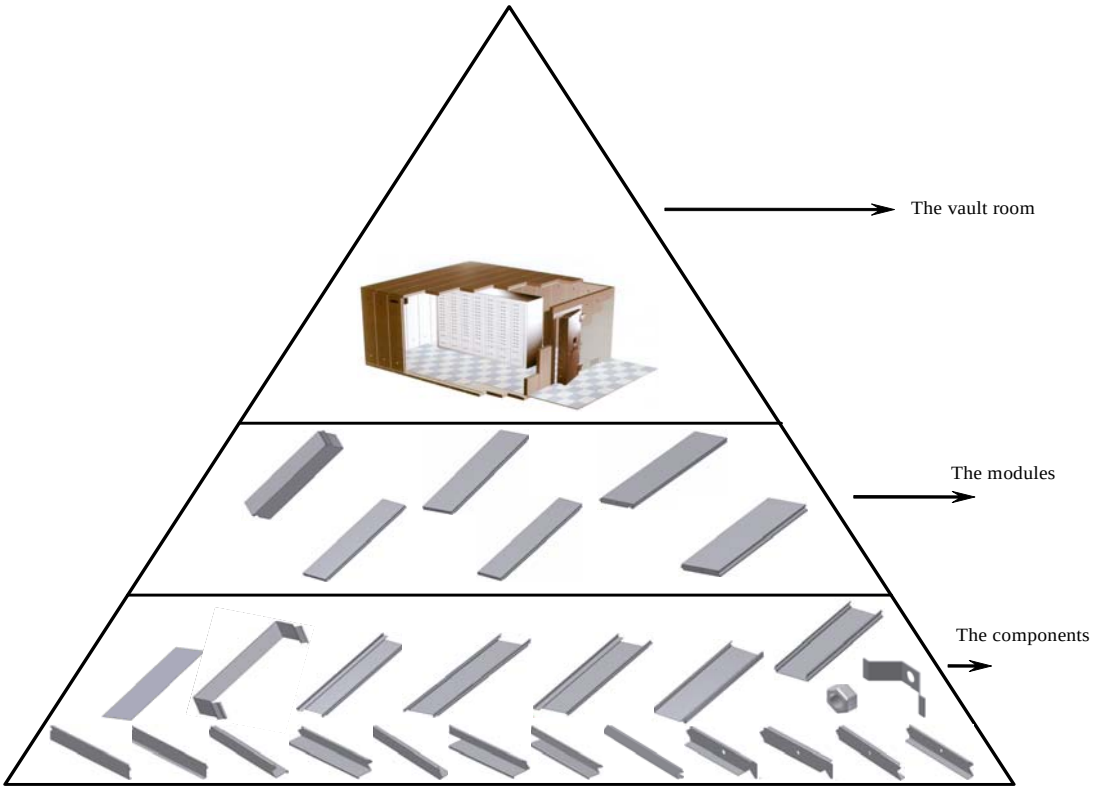

Figure 5: *Hierarchial structure of modular vault room with components*

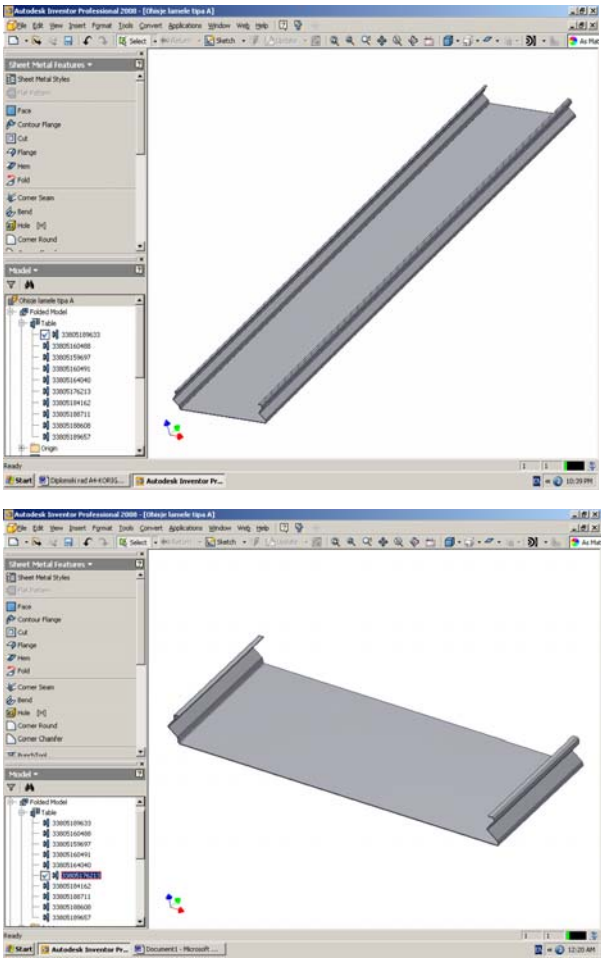

Figure 8: *Change of geometric model of cover plate typeA with a change of parametars of length and width*

After defining the customer's requirements and main dimensions of vault room, the designing process now consists of these phases:

- defining of number of basic modules and specification of dimension caracteristics of modules and components,
- designing of modules and components includes the value of dimensions entered in adequate tables of parametars,
- 3D design of vault room.

5. CONCLUSION

The products as a modular vault room "Modulprim" are manufactured according to customer's requirements. Customer selects a security grades and defines available dimensions of vault room. The concept which is based on modular structure assures preferences of a serial production and design of product which responses at customer's specific demands. However, every vault room is a new project without possibility to make a model or a prototype. 3D design which is available to modern CAD software provides a possibility to make virtual prototype of a vault room.

The geometry of modules of a vault room is the same for every new project and the difference is in the number of elements and dimensions. The preference of the use of modern CA (Computer Aided) tools and a concept of parametric modelling is reduction of time design for 90%. Now it is possible to make a hight-quality product because drawings are of high-quality without design errors.

Suggested approach to the designing of modular vault room with modern Computer Aided tools enables quick response at customer's specific demands, better product quality and reduction of manufacturing expenses. This approach increases efficiency of the whole manufacturing system and its competitivness at market.
It is planned in the future a software for automatic generate of parametars to be made after defining customer requirements and main dimensions of vault room.

6. REFERENCES

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