A GENERATIVE MODEL FOR ANATOLIAN MEDRESES BY ANALYZING OF PRECEDENT

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In this study, medreses, which are the educational buildings of a period in Anatolia, are analyzed. For this analysis Seljuks State medreses' with open courtyard and 1 storey type are chosen. By analyzing their topological and geometrical properties, parametric shape grammar rules are defined then new plan layouts are generated. In this study the translation from a set of design principles of medreses into a shape grammar has been done by hand. The future objective of the study is to implement it in a computer.

KEYWORDS: Shape Grammar; Medreses; analysing architectural precedents

INTRODUCTION

Stiny described shape grammars as a method for formal descriptions of designs. An alphabet of shapes, a strarting shape, and shape rules which defines spatial relations between shapes consititute shape grammars.
The power of shape grammar is obvious in design areas like painting, sculpture, especially in architectural design and in the study of historical architecture (some examples; Palladian Villas and Victorian windows, Frank Lloyd Wright Houses, Alvaro Siza's Malagueira houses, Traditional Turkish Houses). An architectural composition has some principles. These principles can be defined by a set of rules, and these rules form the language of the grammar.
Mark Tapia (1999) describes well the relationship between shape grammars and computer implementations:
Shape grammars naturally lend themselves to computer implementations: the computer handles the bookkeeping tasks (the representation and computation of shapes, rules, and grammars, and the presentation of correct design alternatives) and the designer specifies, explores, develops design languages, and selects alternatives.
People who develop shape grammars have had two choices: either simulate the shape grammar by hand or develop a program on a computer.
In this study the translation from a set of design principles of *medreses* into a shape grammar has been done by hand. With a bottom-up approach architectural language and a vocabulary of medreses are defined, then this vocabulary transformed into a shape grammar and finally a variety of medrese plan layouts are generated.

MEDRESES

Courtyard with eyvans plan layout is a common scheme, used in central Asia, Iran, and in other parts of the Muslim world. It functions equally and perfectly for different functions, as medrese, caravanserai, palace and mosque.
Medrese is a building type which has an important role in the development process of Turkish Islamic architecture and the cultural content of Middle Ages Anatolia. In *medrese*s experimental and religious sciences were educated freely. These educational buildings have their own specific, architectural characteristics. *Medrese*s consist of a big classroom and enough number of student rooms.

ERZURUM, ÇİFTE MİNARELİ MEDRESE

KAYSERİ, HUAND HATUN MEDRESESİ

ANTALYA, IMARET MEDRESESI

KAYSERİ, SERACEDDIN MEDRESESİ

Figure 4. Some photographs and plans of medereses

In Seljuk Anatolia's there were two types of *medrese*s; "*medrese* with open courtyard", and "*medrese* with vaulted central area".

On the entrance part there is a big chief doorway (main door). By passing from the main door through a vaulted passage you reach to the courtyard. There is a big *eyvan* on the opposite facade of entrance and courtyard, which is used as a common classroom.

Through the entrance and big *eyvan*'s right and left side there are student rooms. Generally in the middle of these rooms there is an *eyvan* and in front of them there are colonnades (*revak*). In these rooms students could study with their teachers in Private.

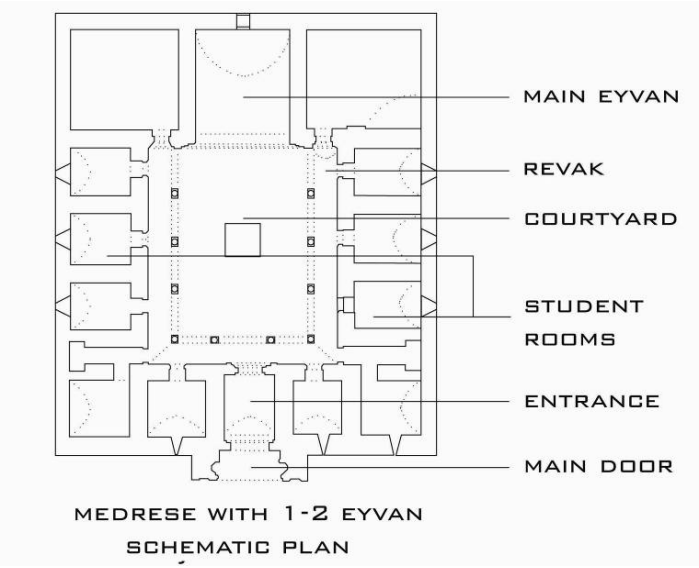


Figure 1. Schematic plan of medrese with 1-2 eyvan

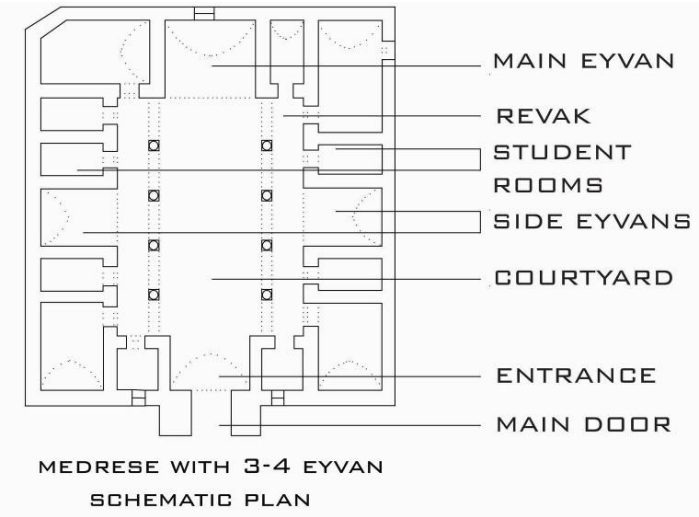


Figure 2. Schematic plan of medrese with 3-4 eyvan

THE GENERATION PROCESS

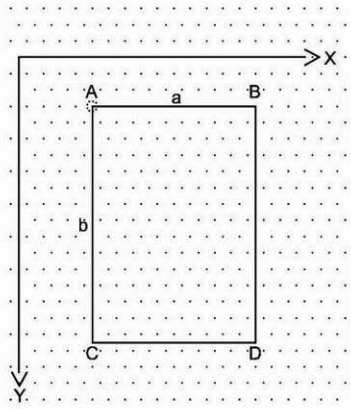
By analyzing different types of *medrese* plans, some general decisions have taken about building elements, dimensions, proportions and plan schemes. Geometrical and topological constrains are the followings:

- The entrance must be from the short façade;
- Axes of entrance and big *eyvan* must be on the same direction;
- If there are side *eyvan*s, they must be in the middle;
- If there are side *eyvan*s, they must be smaller than big one;
- There must be colonnade (*revak*) in front of student's rooms;
- Dimensions of the axes of colonnade and columns must be chosen from knowledge base.

The steps of generation:

- Defining general dimensions of layout;
- Placing main entrance and big (main) *eyvan*;
- Placing and measuring student cells, and (if there is) side *eyvan*s;

- Placing colonnades;
- Defining the place of chief doorway.



K1. DEFINING DIMENSIONS OF THE STARTING SHAPE

a: parallel to the x axis and $21 \leq x \leq 27$

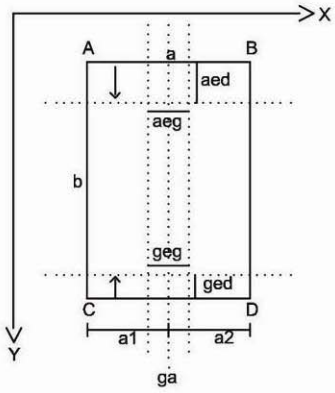
b: parallel to the x axis and $26 < y < 43$

$a \leq b$ (must be)

proportion of a/b : $1 < a/b < 1.6$

$a < b$ (must be)

DEFINITION: Main shape is generated by starting from point A.
Generally main shape is in a rectangular form.



K2. ENTRANCE AXIS

K2.1. WIDTH OF ENTRANCE AXIS

entrance axis(ga) must be just in the middle of short side

width of entrance eyvan (geg) : $3 < geg < 7$

.entrance eyvan and main entrance (aeg) may be in the same dimensions

.but entrance eyvan's width cannot be more than main eyvan's width

K2.2 DEPTH OF ENTRANCE EYVAN

depth of entrance eyvan (ged): $3 < ged < 7$

depth of entrance eyvan can be defined parallel to the |CD| direction, with measurements written above

K3. MAIN EYVAN

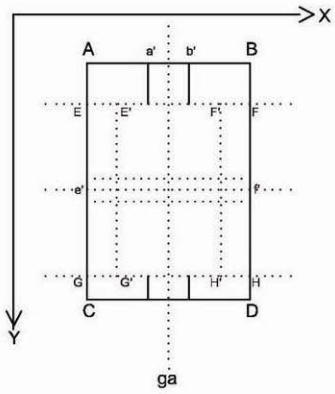
K3.1 WIDTH OF MAIN EYVAN

width of entrance eyvan (aeg) : $5 < aeg < 10$

K3.2 DEPTH OF MAIN EYVAN

width of main eyvan (aed): $5 < aed < 10$

depth of entrance eyvan can be defined parallel to the |AB| direction, with measurements written above



K4. STUDENT ROOMS AND SIDE EYVANS

K4.1. IF THERE ARE SIDE EYVANS : ROOMS AND SIDE EYVANS

(After defining dimensions of entrance and main eyvan we get some helping points ; E,F,G,H)

K4.1. 1. WIDTH OF SIDE EYVAN

|EG|=|FH|

Mid point of |EG| and |FH| sides locates the axis of side eyvans : |e'f'|

.Width of side eyvan (yeg) $3 < yeg < 8$

.Side eyvan cannot be wider than main eyvan

$yeg \leq aeg$

Side eyvan width is defined by shifting equally |e'f'| side through |AB| and |CD| sides.

K4.1. 2. DEPTH OF SIDE EYVAN

|EG|=|FH|

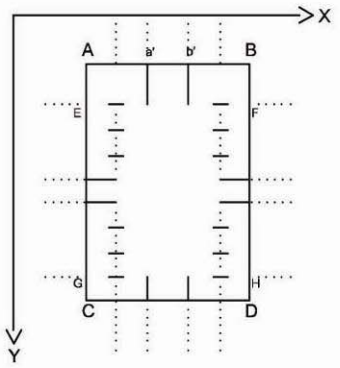
.Depth of side eyvan (yed) $3 < yed < 8$

.Side eyvan cannot be deeper than main eyvan :

$yeg \leq aeg$

Side eyvan depth is defined by shifting equally |EG| and |FH| sides through inside.

K4. STUDENT ROOMS AND SIDE EYVANS



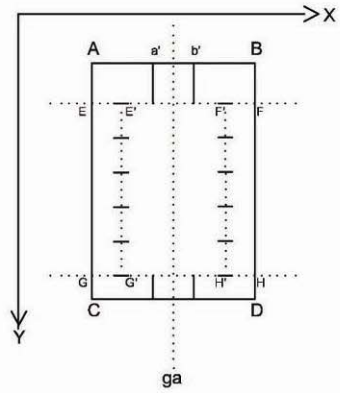
K4.1. 3. LOCATING STUDENT ROOMS

After defining side eyvans on |EG| ve |FH| sides, left pieces are divided equally to get student rooms.

Rooms can be behind or on the same line with side eyvans:

.Side eyvan depth (yed) 3<yed<8 —> room depth 3<hd<8

. Room width (hg) 2<hg<8 —> if the left piece is smaller than 2, then no division occurs and one room is located.



K4.2 ROOMS; IF THERE IS NOT SIDE EYVANS

(After defining dimensions of entrance and main eyvan we get some helping points ; E,F,G,H)

K4.2. 1. ROOM DEPTH

|EG|=|FH|

Room depth is defined by shifting |EG| and |FH| sides through inside

|E'G'| and |F'H'| are generated

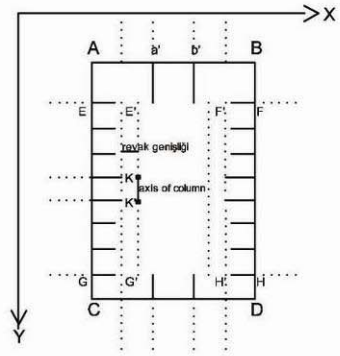
Room depth (hd) 2<hd<5

K4.2. 2. ROOM WIDTH

|E'G'|=|F'H'|

|E'G'| AND |F'H'| sides are divided according to the measurements written below

Room width: 2<hd<6



K5 REVAK

K5.1. IF THERE ARE SIDE EYVANS

K5.1. 2 LOCATING SIDE EYVANS

By shifting |E'G'| and |F'H'| axis, the places of comuns are defined.

Column measurements 0.6*0.6 m

Width of revak 13≤rg≤25

K5.1. 2 LOCATING THE COLUMNS

There are 3 choises for locating Revak columns through |AC| side:

can be on the axis of main eyvan's side walls.

can be on the axis ofentrance eyvan's side walls.

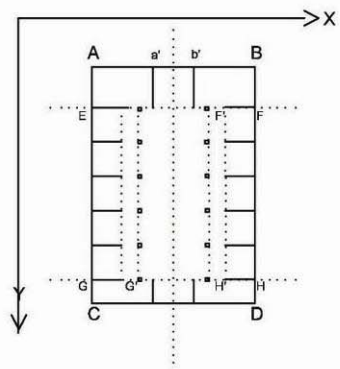
can be independent from both axis.

Column axis (ka) 20<ka<30

Firstly columns are placed through the wall of side eyvans.

Other columns are placed according to the measurements written below.

Column axis 20<ka<30



K4.2. 2. IF THER IS NOT SIDE EYVANS

|E'G'|=|F'H'|

|E'G'| and |F'H'| sides are divided equally accoeding to the measurements written below.

Column axis: 20<ka≤30

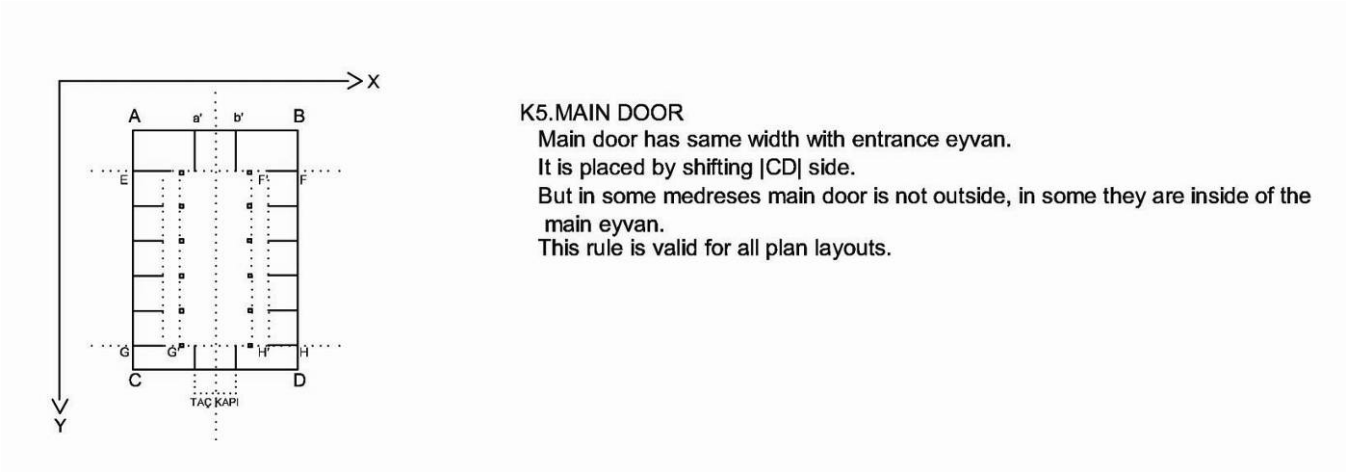


Figure 4. Steps of generation

At the end of this process two different kinds of layouts (one with side *eyvan*s, one without side *eyvan*s) and variations of them are generated.

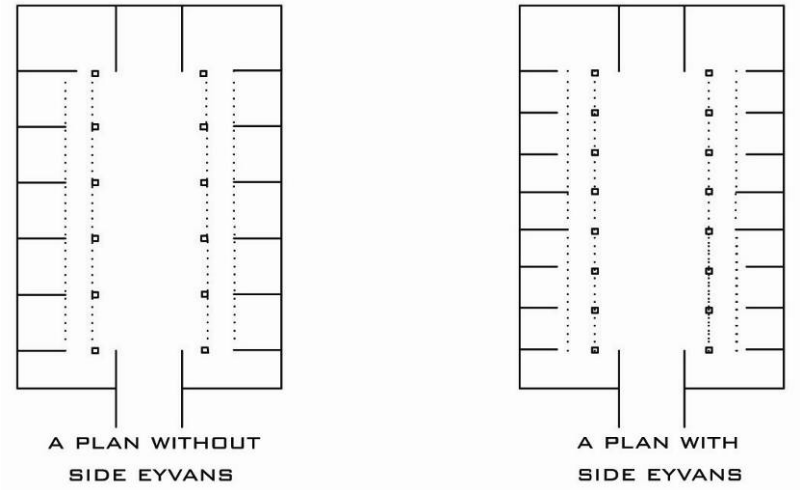


Figure 5. Examples of produced layouts

CONCLUSION

The main objective of this work is to analyze the precedent for producing architectural knowledge about Anatolian Seljuk's medreses. The most important part is to understand design process and architectural content of *medrese*s' and adapt this knowledge today's design. For this adaptation parametrical shape grammer rules and generation methods are used.

The educational value of the shape grammars is clear. The generation process of designs can be made explicit by specifying the shape rules. The shape grammar developed in this study helps to facilitate the students' understanding of the formal compositions of *Seljuk's medrese*s clearly.

REFERENCES

Sozen, M., 1970, Anadolu Medreseleri, İstanbul Teknik Üniversitesi Matbaası, İstanbul.

Stiny, G.: 1980, Introduction to shape and shape grammars, Environment and Planning B: Planning and Design 7, 343–351.

Tapia M A, 1999, "A visual implementation of a shape grammar system"
Environment and Planning B: Planning and Design 26, 59–73.

Yetkin, K. S., 1970, Türk Mimarisi, Bilgi Basımevi, Ankara.
http://www.dallog.com/index.html, 23.09.2007
http://www.shapegrammar.org, 23.09.2007
http://tr.wikipedia.org, 23.09.2007