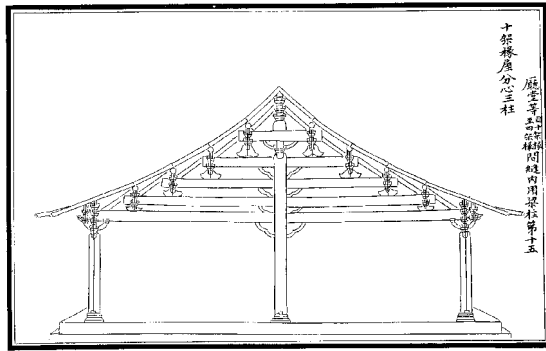
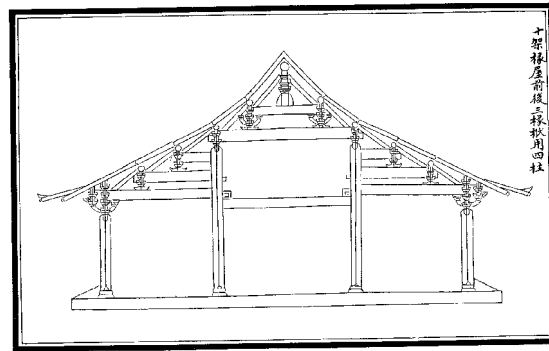


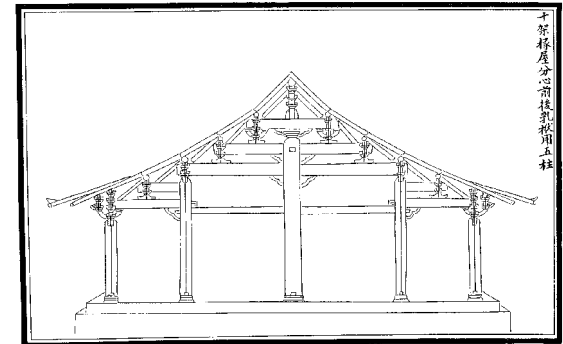
Figure 1. The rules for determining the roof section, known as *juzhe*, as drawn by Liang (1983, 265). With these rules, and given the depth and type of building, the correct roof section can be calculated.



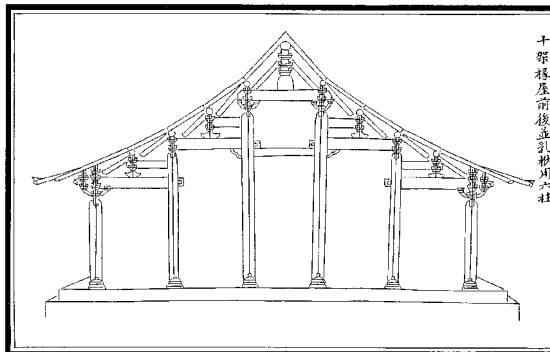
a. *Shijia chuan wu, fen xin, [yong] san zhu*. 10-rafter building, centrally divided, [with] 3 columns.



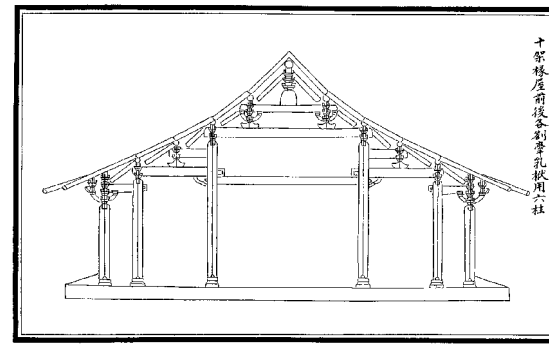
b. *Shijia chuan wu, qian hou sanchuan fu, yong si zhu*. 10-rafter building, a 3-rafter beam in front and in back, with 3 columns.



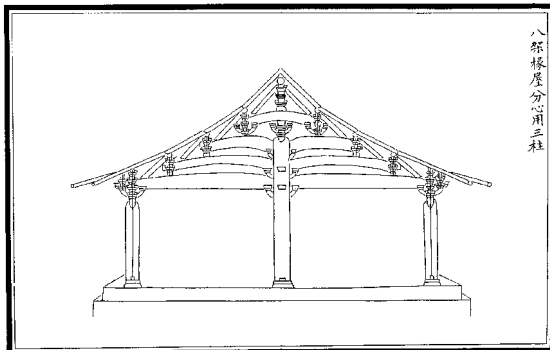
c. *Shijia chuan wu, fen xin, qian hou rufu, yong wu zhu*. 10-rafter building, centrally divided, a 2-rafter beam in front and in back, with 5 columns.



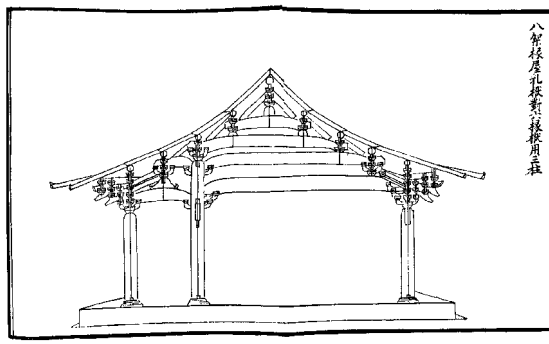
d. *Shijia chuan wu, qian hou bing rufu, yong wu zhu*. 10-rafter building, 2 2-rafter beams in front and in back, with 5 columns.



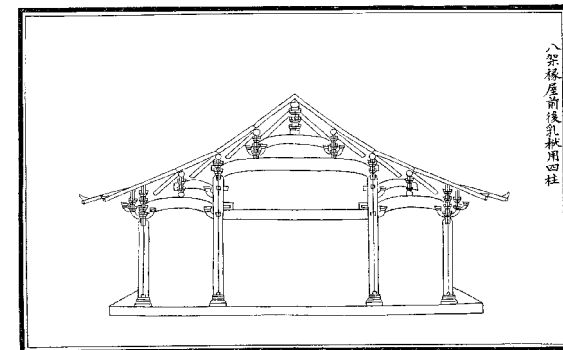
e. *Shijia chuan wu, qian hou ge zhaqian rufu, yong liu zhu*. 10-rafter building, 1- and 2-rafter beams both in front and in back, with 6 columns.



f. *Bajia chuan wu, fen xin, yong san zhu*. 8-rafter building, centrally divided, with 3 columns.

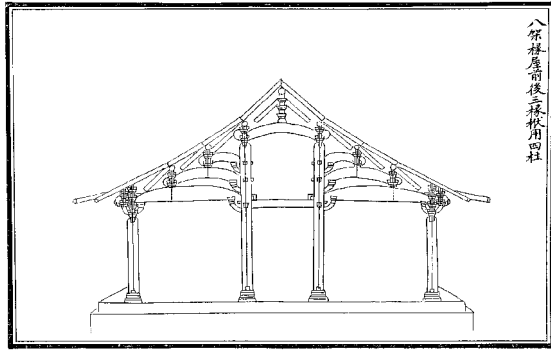


g. *Bajia chuan wu, rufu dui liuchuan fu, yong san zhu*. 8-rafter building, a 2-rafter beam abutting a 6-rafter beam, with 3 columns.

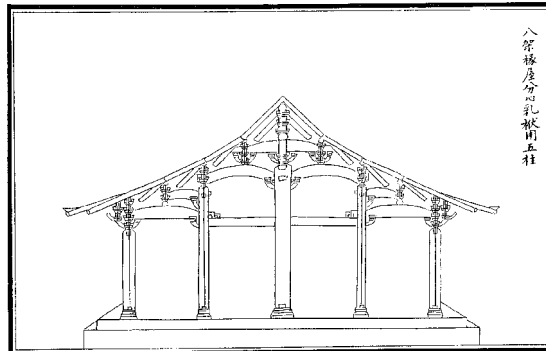


h. *Bajia chuan wu, qian hou rufu, yong si zhu*. An 8-rafter building, a 2-rafter beam in front and in back, with 4 columns.

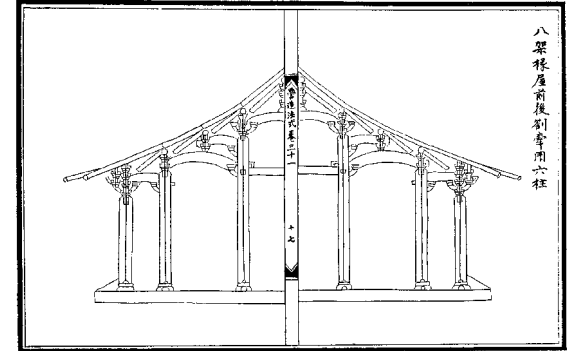
Figure 2. The 18 *ting tang* sections, with descriptions (Liang 1983, 313–321).



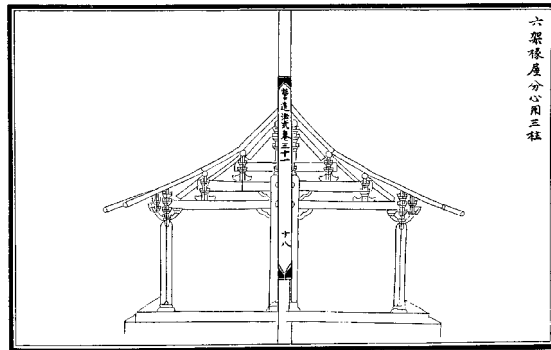
i. *Bajia chuan wu, qian hou sanchuan fu, yong si zhu*. 8-rafter building, a 3-rafter beam in front and in back, with 4 columns.



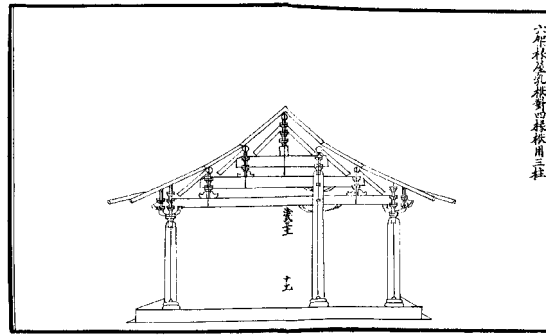
j. *Bajia chuan wu, fen xin, qian hou rufu, yong wu zhu*. 8-rafter building, centrally divided, a 2-rafter beam in front and in back, with 5 columns.



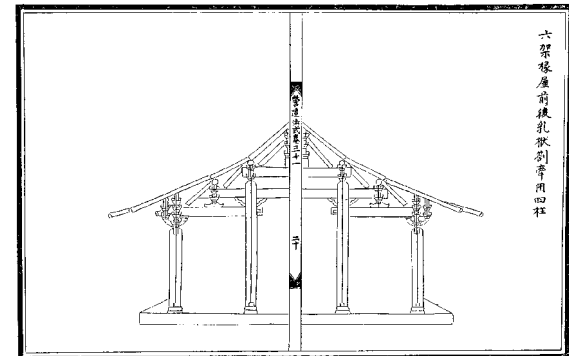
k. *Bajia chuan wu, qian hou zhaqian [rufu], yong liu zhu*. 8-rafter building, a 1- and a 2-] rafter beam in front and in back, with 6 columns.



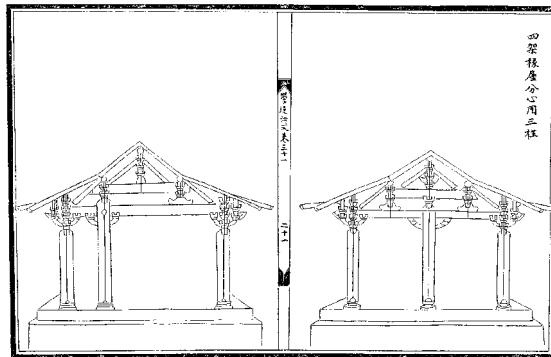
l. *Liujia chuan wu, fen xin, yong san zhu*. 6-rafter building, centrally divided, with 3 columns.



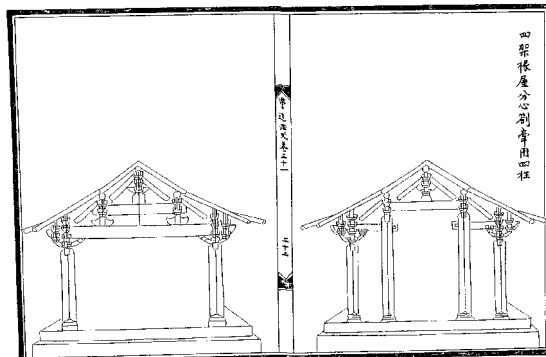
m. *Liujia chuan wu, rufu dui sichuan fu, yong san zhu*. 6-rafter building, a 4-rafter beam abutting a 2-rafter beam, with 3 columns.



n. *Liujia chuan wu, qian hou rufu, yong si zhu*. 6-rafter building, a 2-rafter beam in front and in back, with 4 columns.



o. Left: [*Sijia chuan wu, zhaqian dui sanchuan fu, yong san zhu*. 4-rafter building, a 1-rafter beam abutting a 3-rafter beam, with 3 columns.] Right: *Sijia chuan wu, fen xin, yong san zhu*. 4-rafter building, centrally divided, with 3 columns.



p. Left: [*Sijia chuan wu, tongyan, yong er zhu*. 4-rafter building, clear span, with 2 columns.] Right: *Sijia chuan wu, qian hou zhaqian, yong si zhu*. 4-rafter building, a 1-rafter beam in front and in back, with 4 columns.

Figure 2, continued.

Initial shape $p$	$\square \cdot$		
Initial description $s$	1		
Initial description $d$	0		
$\begin{array}{c} \square \cdot \\ + \end{array} \xrightarrow{1} \begin{array}{c} \square \square \cdot \\ + \end{array}$	$\begin{array}{c} \square \cdot \\ + \end{array} \xrightarrow{2} \begin{array}{c} \square \diamond \cdot \\ + \end{array}$	$\begin{array}{c} \diamond \cdot \\ + \end{array} \xrightarrow{3} \begin{array}{c} \diamond \square \cdot \\ + \end{array}$	$\begin{array}{c} \diamond \cdot \\ + \end{array} \xrightarrow{4} \begin{array}{c} \diamond \diamond \cdot \\ + \end{array}$
$s \leftarrow s + 1$	$s \leftarrow s$	$s \leftarrow s + 1$	$s \leftarrow s$
$d \leftarrow d$	$d \leftarrow d + 1$	$d \leftarrow d$	$d \leftarrow d + 1$
$\cdot \xrightarrow{5}$			
$s \leftarrow s$			
$d \leftarrow d$			

Figure 3. A simple grammar that generates designs, each made of (1) a shape  $p$  of squares and diamonds, (2) a description indicating the number  $s$  of squares in the shape, and (3) a description indicating the number  $d$  of diamonds. The grammar consists of an initial design and five design rules. The initial design consists of an initial shape – one square with one dot – and initial descriptions  $s = 1$  and  $d = 0$ . Each rule consists of a shape subrule and two description subrules. Rules 1 through 4 each add one square (or one diamond) and one dot, and increase  $s$  or  $d$  by 1. Rule 5 erases a dot and leaves  $s$  and  $d$  unchanged.

<i>p</i>	$\square \cdot$						$\xRightarrow{5}$	$\square$			
<i>s</i>	1						$\Rightarrow$	1			
<i>d</i>	0						$\Rightarrow$	0			
<i>p</i>	$\square \cdot$	$\xRightarrow{1}$	$\square \square \cdot$	$\xRightarrow{1}$	$\square \square \square \cdot$	$\xRightarrow{1}$	$\square \square \square \square \cdot$	$\xRightarrow{5}$	$\square \square \square \square$		
<i>s</i>	1	$\Rightarrow$	2	$\Rightarrow$	3	$\Rightarrow$	4	$\Rightarrow$	4		
<i>d</i>	0	$\Rightarrow$	0	$\Rightarrow$	0	$\Rightarrow$	0	$\Rightarrow$	0		
<i>p</i>	$\square \cdot$	$\xRightarrow{1}$	$\square \square \cdot$	$\xRightarrow{2}$	$\square \square \diamond \cdot$	$\xRightarrow{3}$	$\square \square \diamond \square \cdot$	$\xRightarrow{1}$	$\square \square \diamond \square \square \cdot$	$\xRightarrow{5}$	$\square \square \diamond \square \square$
<i>s</i>	1	$\Rightarrow$	2	$\Rightarrow$	2	$\Rightarrow$	3	$\Rightarrow$	4	$\Rightarrow$	4
<i>d</i>	0	$\Rightarrow$	0	$\Rightarrow$	1	$\Rightarrow$	1	$\Rightarrow$	1	$\Rightarrow$	1
<i>p</i>	$\square \cdot$	$\xRightarrow{2}$	$\square \diamond \cdot$	$\xRightarrow{3}$	$\square \diamond \square \cdot$	$\xRightarrow{2}$	$\square \diamond \square \diamond \cdot$	$\xRightarrow{3}$	$\square \diamond \square \diamond \square \cdot$	$\xRightarrow{5}$	$\square \diamond \square \diamond \square$
<i>s</i>	1	$\Rightarrow$	1	$\Rightarrow$	2	$\Rightarrow$	2	$\Rightarrow$	3	$\Rightarrow$	3
<i>d</i>	0	$\Rightarrow$	1	$\Rightarrow$	1	$\Rightarrow$	2	$\Rightarrow$	2	$\Rightarrow$	2

Figure 4. Derivations of four designs. Each successive transformation of the design is separated by a double arrow with the number of the rule applied. In each case, the last step is to remove the dot.

<i>p</i>	□ ◇ ◇ ◇ ◇	□ ◇ ◇ ◇ □	□ ◇ □ □ ◇ ◇ □ ◇	□ ◇ □ ◇ ◇ ◇ □ ◇ ◇ ◇ ◇ ◇ □ □ ◇
<i>s</i>	1	2	4	5
<i>d</i>	4	3	4	10

Figure 5. Four designs created by the grammar in figure 3.

initial $s_4$		initial $s_6$		initial $s_8$		initial $s_{10}$	
initial $c_{a4}$ initial $c_{b4}$ initial $c_{c4}$	<i>sijia chuan wu</i> $\emptyset$ <i>yong er zhu</i>	initial $c_{a6}$ initial $c_{b6}$ initial $c_{c6}$	<i>liujia chuan wu</i> $\emptyset$ <i>yong er zhu</i>	initial $c_{a8}$ initial $c_{b8}$ initial $c_{c8}$	<i>bajia chuan wu</i> $\emptyset$ <i>yong er zhu</i>	initial $c_{a10}$ initial $c_{b10}$ initial $c_{c10}$	<i>shijia chuan wu</i> $\emptyset$ <i>yong er zhu</i>
initial $e_{a4}$ initial $e_{b4}$ initial $e_{c4}$	4-rafter building $\emptyset$ with 2 columns	initial $e_{a6}$ initial $e_{b6}$ initial $e_{c6}$	6-rafter building $\emptyset$ with 2 columns	initial $e_{a8}$ initial $e_{b8}$ initial $e_{c8}$	8-rafter building $\emptyset$ with 2 columns	initial $e_{a10}$ initial $e_{b10}$ initial $e_{c10}$	10-rafter building $\emptyset$ with 2 columns
	1		2				
$c_b \leftarrow$ <i>tong yan</i>		$c_b \leftarrow$ <i>fen xin</i> $c_c \leftarrow$ <i>yong n + 1 zhu</i>					
$e_b \leftarrow$ clear span		$e_b \leftarrow$ centrally divided $e_c \leftarrow$ with $n + 1$ columns					

Figure 6. Section grammar for *ting tang*. It consists of four initial designs – of 4-, 6-, 8-, and 10-rafter buildings – and 14 rules. Each design consists of a section (shape), a 3-part Chinese description, and a 3-part English description.

<p><math>C_b \leftarrow C_b</math>, <i>qian zhaqian</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>qian rufu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>qian sanchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>qian sichuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>
<p><math>e_b \leftarrow e_b</math>, 1-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 2-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 3-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 4-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>
<p><math>C_b \leftarrow C_b</math>, <i>qian wuchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>qian liuchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>		
<p><math>e_b \leftarrow e_b</math>, 5-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 6-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>		
<p><math>C_b \leftarrow C_b</math>, <i>hou zhaqian</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>hou rufu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>hou sanchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>hou sichuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>
<p><math>e_b \leftarrow e_b</math>, 1-rafter beam in back  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 2-rafter beam in back  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 3-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 4-rafter beam in back  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>
<p><math>C_b \leftarrow C_b</math>, <i>hou wuchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>	<p><math>C_b \leftarrow C_b</math>, <i>hou liuchuan fu</i>  <math>C_c \leftarrow C_c</math>, <i>yong n + 1 zhu</i></p>		
<p><math>e_b \leftarrow e_b</math>, 5-rafter beam in front  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>	<p><math>e_b \leftarrow e_b</math>, 6-rafter beam in back  <math>e_c \leftarrow e_c</math>, with <math>n + 1</math> columns</p>		

Figure 6, continued.



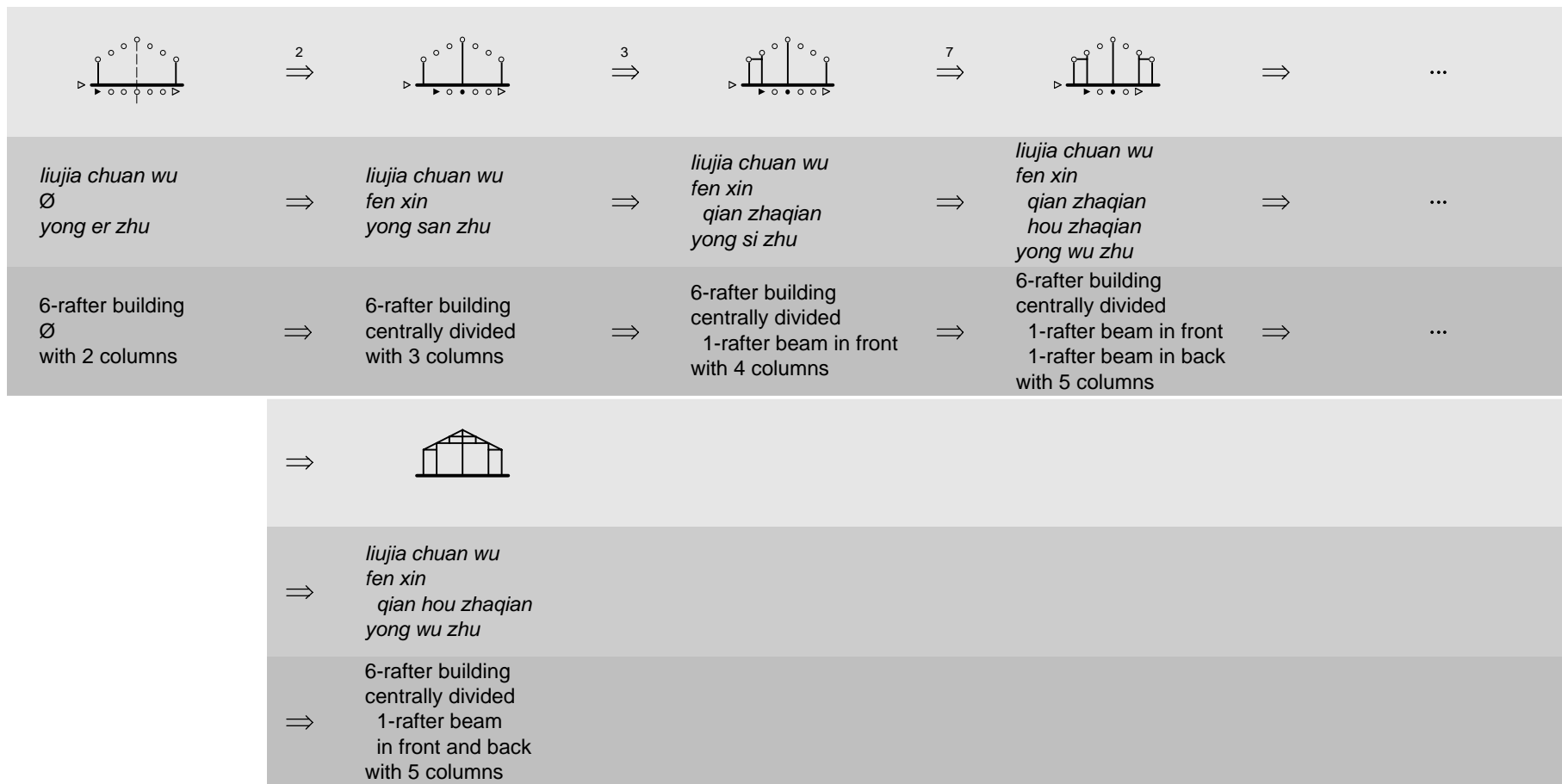
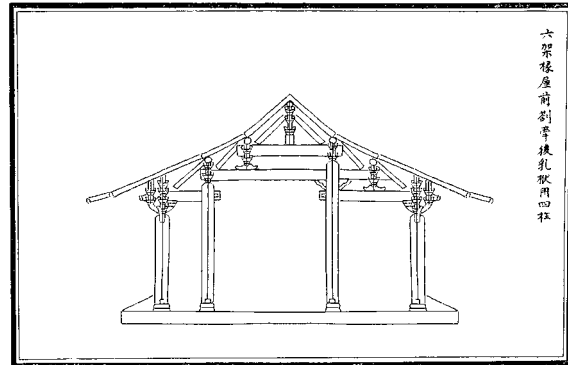
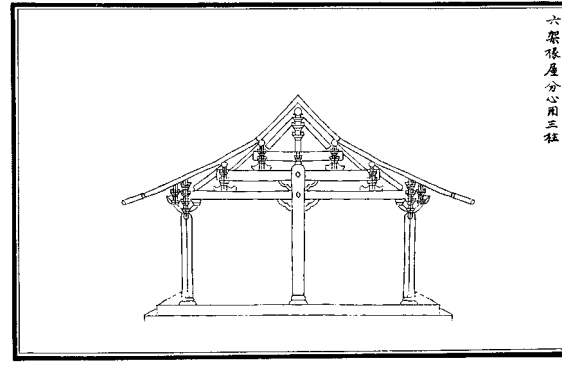


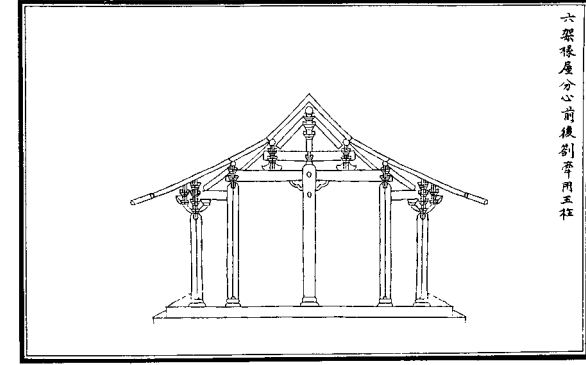
Figure 7. Derivation of a 6-rafter *ting tang*, centrally divided, 1-rafter beam in front and in back, with 5 columns. We apply rules 2, 1, and 7 to establish the distinctive features. We omit the process of cleaning up the labels and descriptions. It is shown in figure 8, redrawn as in the *Yingzao fashi*.



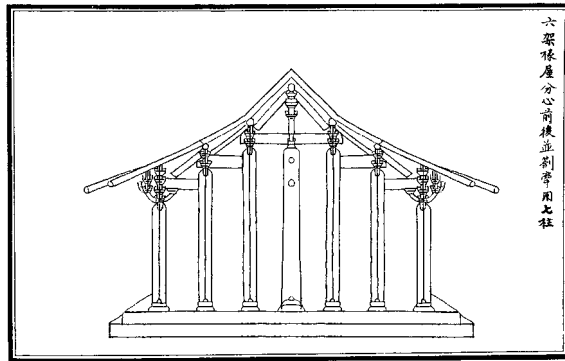
a. *Liujia chuan wu, qian zhaqian hou rufu, yong si zhu*. A 6-rafter building, a 1-rafter beam in front, a 2-rafter beam in back, with 4 columns.



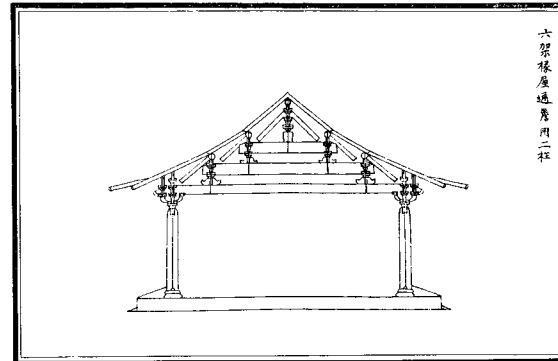
b. *Liujia chuan wu, fen xin, yong san zhu*. A 6-rafter building, centrally divided, with 3 columns.



c. *Liujia chuan wu, fen xin, qian hou zhaqian, yong wu zhu*. A 6-rafter building, centrally divided, a 1-rafter beam in front and in back, with 5 columns.



d. *Liujia chuan wu, fen xin, qian hou bing zhaqian, yong qi zhu*. A 6-rafter building, centrally divided, 2 1-rafter beams in front and in back, with 7 columns.



e. *Liujia chuan wu, tong yan, yong er zhu*. A 6-rafter building, clear span, with 2 columns.

Figure 8. Five 6-rafter sections derived with the grammar. Whether or not they are legal is for the user of the grammar to determine. The third section is derived in figure 7.