Boundary matrix reduction

$$B = $$

	1	2	3	4	12	14	23	24	34	234
0	B_0									
1					B_1					
2										
3										
4										
12										B_2
14										
23										
24										
34										

Boundary matrix reduction

$$B =$$

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1	1		
3							1		1	
4						1		1	1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1	1		
3							1		1	
4						1		1	1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1	1		
3							1		1	
4						1		1	1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1	1		
3							1		1	
4						1		1	1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					**1**		1	1		
3							**1**		1	
4						**1**		1	1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1		1		
2					1		1	1		
3							1		1	
4						1			1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					**1**		1			
3							**1**		1	
4						**1**			1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1		1	
4						1			1	
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1			1	
2					1		1			
3							1		1	
4						1				
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1			1	
2					1		1		1	
3							1			
4						1				
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1			
4						1				
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1			
4						1				
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

$$\mathbf{R} =$$

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1			
4						1				
12										
14										
23										1
24										1
34										1

Boundary matrix reduction

$\mathbf{R} =$

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1			
4						1				
12										
14										
23										1
24										1
34										1

$$\beta_0 = 4 - 3 = 1$$

Boundary matrix reduction

$$\mathbf{R} =$$

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					1		1			
3							1			
4						1				
12										
14										
23										1
24										1
34										1

$$\beta_1 = \overset{\bullet}{2} - \overset{\bullet}{1} = 1$$

Boundary matrix reduction

$$\mathbf{R} =$$

	1	2	3	4	12	14	23	24	34	234
0										
1					1	1				
2					**1**		1			
3							**1**			
4						**1**				
12										
14										
23										1
24										1
34										**1**

$$\beta_1 = \overset{\textcolor{cyan}{\bullet}}{2} - \overset{\textcolor{magenta}{\bullet}}{1} = 1$$

$$\beta_k = \mathrm{rk}Z_k - \mathrm{rk}B_k$$