

Comparative Numerical Simulation of Masonry Arch with Different Interlocking Pattern

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INTRODUCTION: Arches being one of the most aesthetic and stable form of structural elements, have been constantly used since hundreds of years in various form of constructions be it buildings, bridges or any other structural system. Moreover, with growing interest in pre-fabricated block structures these days, dry stack arches without mortar can provide a good solution for faster and stable construction. This paper deals with the simulation of dry stack arches composed of different patterns of interlocking blocks to increase the sliding resistance.

TYPES OF ARCH :

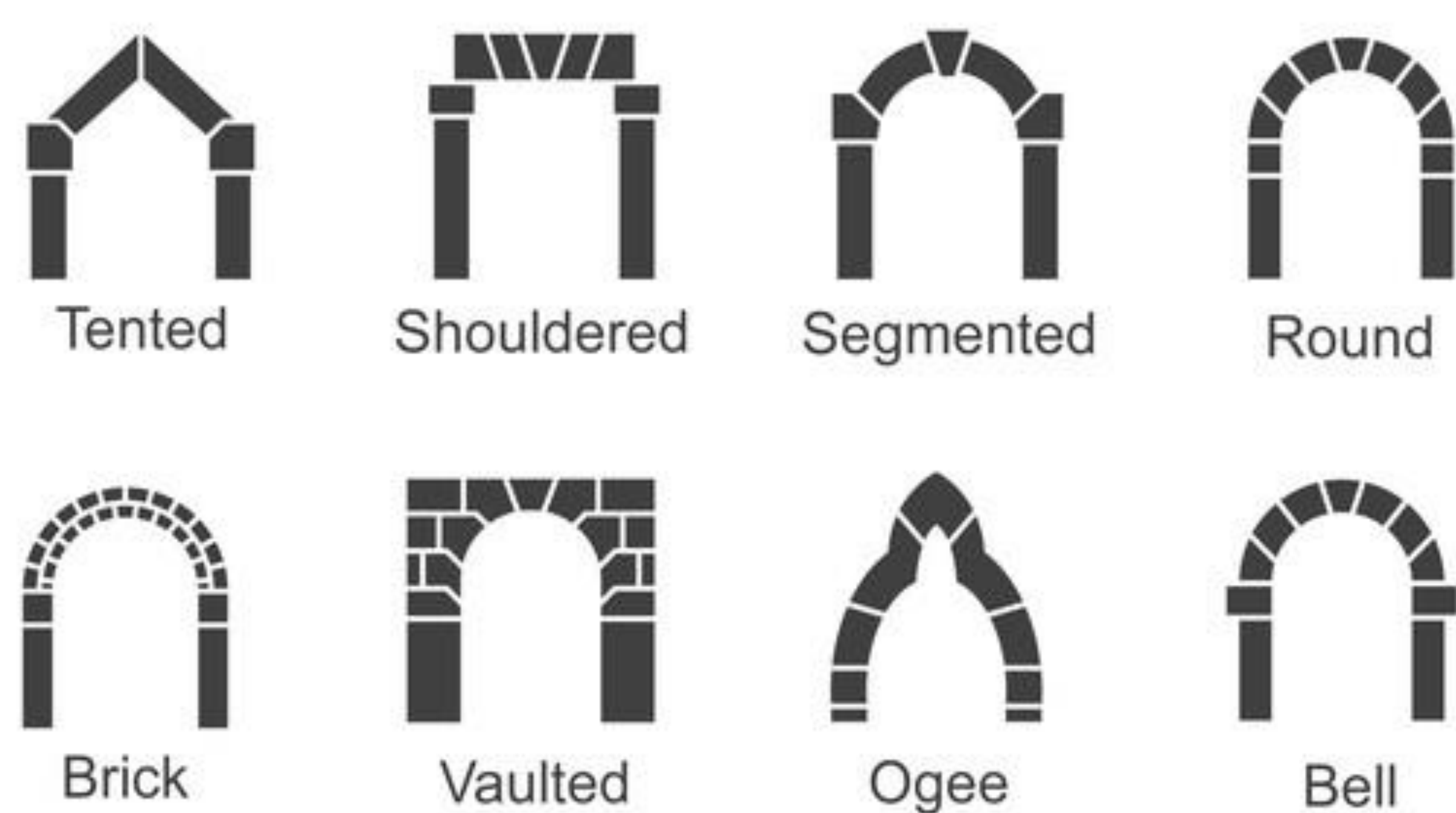


Figure 1. Types of Arches

Interlocking frictional surfaces:

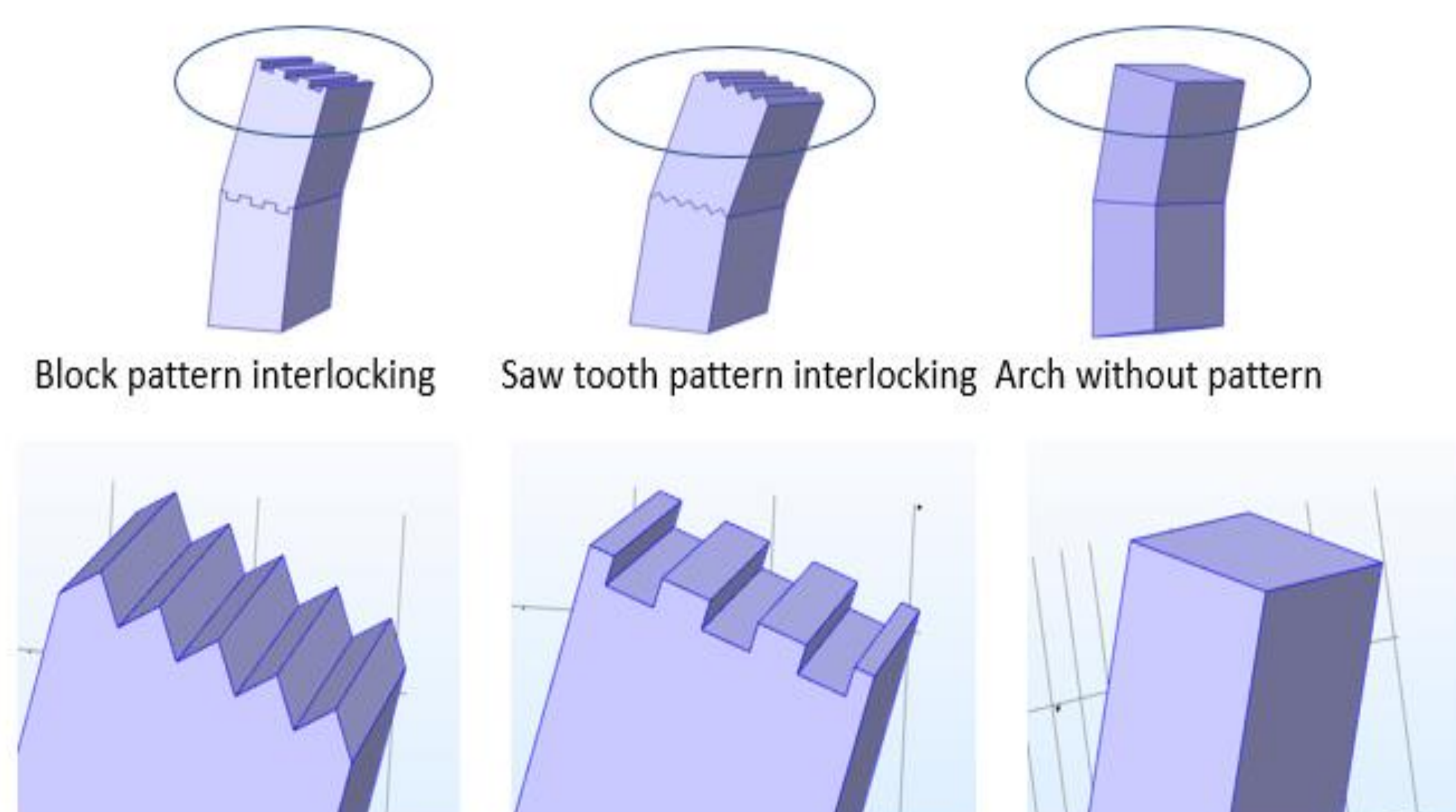


Figure 2. Interlocking pattern

COMPUTATIONAL METHODS: Simulation of these models have been done with stationary solver in Structural Mechanics Module in COMSOL Multiphysics® 5.4. A 1000KN Point load is applied in at centre of the arches.

REFERENCES:

- 1.C. Casapulla, E. Mousavian, M. Zarghani, A digital tool to design structurally feasible semi-circular masonry arches composed of interlocking blocks, Computers and Structures 221 (2019) 111–126.
- 2.J. Heyman, The stone skeleton, International Journal of solids and structures, 2(2) (1966) 249-279.

Geometric conditions: Span of arches is taken as 2m made up of 19 blocks. Friction arch composed of blocks with no such pattern, having 0.6 as friction coefficient value between interface. However, no blocks are provided in solid arch.

RESULT: Generally, stability of arch depend upon the interface area of the block, greater the area less will be the deformation. In terms of displacement, sawtooth arch shows more deformation as compared to other arch Whereas in case of solid arch displacement is less. Similarly in case of shear stress, friction arch shows high shear stress values.

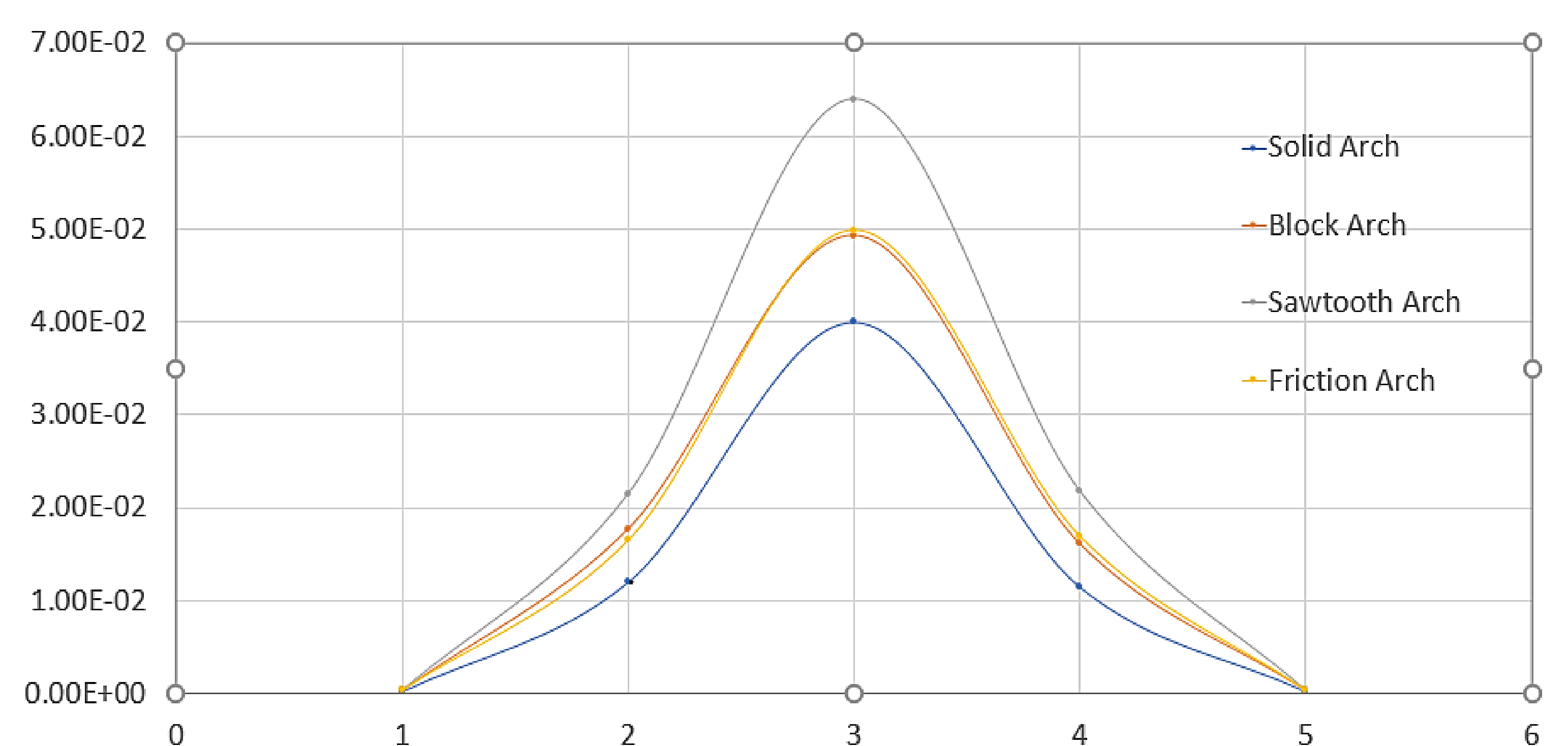


Figure 4. Location Vs Displacement graph at 1000 KN

Table 1. Displacement value at different location at 1000 KN

Distance/Type	Displacement (mm)			
	Solid Arch	Block Arch	Sawtooth Arch	Friction Arch
At left support(1)	0.224	0.317	0.3304	0.32444
At left quarter span(2)	12	17.7	21.5	16.453
At centre(3)	40	49.3	64	49.855
At right quarter(4)	11.5	16.1	21.8	16.91
At right support(5)	0.25	0.313	0.328	0.30661

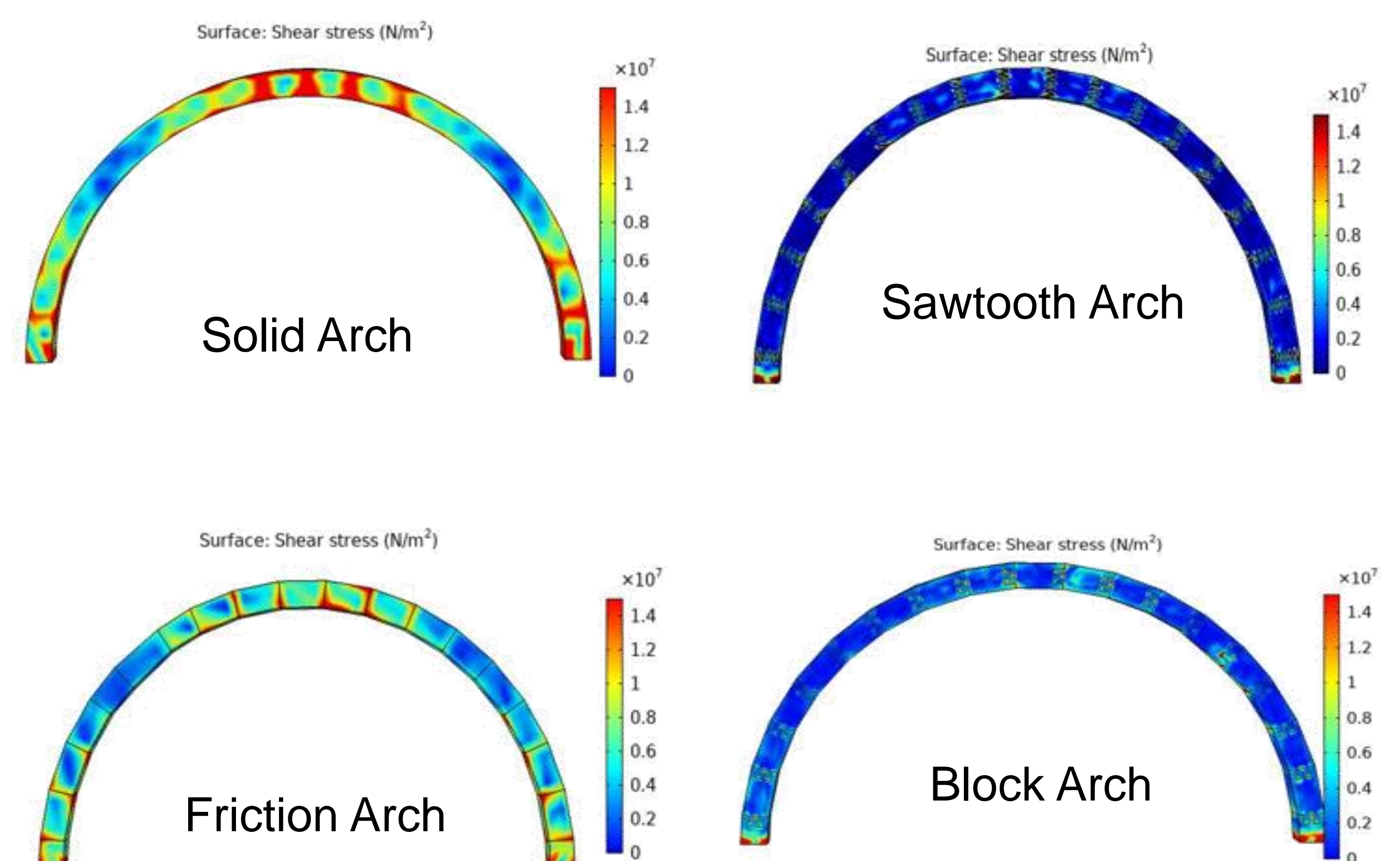


Figure 5. Shear stress pattern under 1000 KN load