

# Randić index and harmonic index of roach graph

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Roach graph which is denoted by  $R_{m,n}$ , resembles a cockroach. It looks like a ladder with few paths removed. It has  $2n$  vertices (where  $n$  and  $m$  vertices are placed in head and body respectively). There are two separate paths with  $m$  vertices and all the opposing vertices are joining as a ladder which can sometimes be represented as a network structure or as a part of it. In 1995, Guattery and Miller used this graph as a counter example to show that some popular spectral separator algorithm perform poorly on this graph. Later, in 2012, formulae for the minimum normalized cut and characteristic polynomial of normalized Laplacian matrix was developed by Perera et.al. According to the literature, very few papers can be found on studying invariant properties of this graph. Therefore we paid an attention to study the two invariant properties namely, Randić index and Harmonic index which are defined as  $R$  and  $H$  respectively while the general Randić index was defined as  $R_\alpha$  by Bollabás and Erdős in 1998. We have proved a general equation for  $R$  and  $H$  in terms of main parameters  $m$  and  $n$  and by considering the two main cases  $m \leq n$  and  $m > n$ . Finally, a relationship was obtained among these two invariant properties and proved that the diameter is an upper bound for the Harmonic Index of roach graph.

**Keywords:** harmonic Index, randić index, roach graph