ABSTRACT. Building on recent work of Robertson and Steger, we associate a $C^*$–algebra to a combinatorial object which may be thought of as a higher rank graph. This $C^*$–algebra is shown to be isomorphic to that of the associated path groupoid. Various results in this paper give sufficient conditions on the higher rank graph for the associated $C^*$–algebra to be: simple, purely infinite and AF. Results concerning the structure of crossed products by certain natural actions of discrete groups are obtained; a technique for constructing rank 2 graphs from "commuting" rank 1 graphs is given.