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Equiangular tight frames (ETFs) and biangular tight frames (BTFs) - sets of unit vectors with basis-like properties whose pairwise absolute inner products admit exactly one or two values, respectively - are useful for a wide range of applications. It is known that harmonic ETFs are characterized by combinatorial objects called difference sets.

This work is dedicated to the study of the underlying combinatorial structures that generate harmonic BTFs. We show that if a harmonic frame is generated by a divisible difference set, a partial difference set or by a special structure with certain Gauss summing properties - all three of which are generalizations of difference sets that fall under the umbrella term “bidifference sets” - then it is either a BTF or an ETF. However, we also show that the relationship between harmonic BTFs and bidifference sets is not as straightforward as the correspondence between harmonic ETFs and difference sets, as there are examples of bidifference sets that do not generate harmonic BTFs. In addition, we study another class of combinatorial structures, the nested divisible difference sets, which yields an example of a harmonic BTF that is not generated by a bidifference set. (Received September 09, 2016)