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Department	Civil Engineering
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Thesis Title	Optimum Design of Non-Prismatic Gable Frame Using Harmony Search Algorithm
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Abstract	This work aims to study the optimum design of steel portal and gable frames based on one of the latest techniques for optimization called the "Harmony Search Algorithm". The objective function is the frame self-weight. Rafters and columns prismatic and non-prismatic sections are the main variables for the design process. Frame height and span are assumed to be determined based on functional requirements of these frames that are usually used in warehouses and mill buildings. The algorithm starts with definition of basic parameters. These include the harmony memory size (number of solution vectors in the harmony search, HMS), harmony memory considering rate (a parameter that is used to improve the solution vector, HMCR), pitch adjusting rate (a parameter that is used to improve the solution vector, PAR). The harmony memory (HM) matrix has been randomly generated from the American section database (metric version). The next step in the algorithm is to improvise the initial harmony memory. The improvisation process depends on HMCR and PAR parameters and also on a randomization process. A new harmony is improvised from either the Initial HM or from entire section list in database. If the new harmony is better than the worst design in the HM (i.e. the last row of the HM), the new design is included in the HM and the existing worst harmony is excluded from the HM. This improvisation step is repeated until the termination criterion is satisfied. In the present work, two termination criteria were used for HS. The first one stops the algorithm when a predetermined total number of searches (number of frame analyses) are performed. The second criterion stops the process before reaching the maximum search number, if more economical design (lighter frame) is not found during a definite number of searches in HS. All forces and moments of statically indeterminate steel frames in this study have

	been determined by charts and coefficient analytical elastic analysis that had been derived using theory of virtual work with neglecting the effects of shearing and ax deformations. Results of harmony algorithm have been compared, in deterministic and in statistical forms, with that obtained by genetic algorithm. Both comparisons show that a harmony search algorithm is more efficient than genetic algorithm. Optimum weights for eight case studies with portal and gable frames, with prismatic and non-prismatic members, and with different support conditions have been determined based on a prepared code for harmony search algorithm. Results have been presented in form of tables and figures with correlation and regression analyses which show that there is a strong linear relationship between frames bent span (as independent variable) and optimum weight (as dependent variable).