INTRODUCTION

Various types of beam column connections in the steel structures have been subjected to a significant number of experimental and theoretical studies in the past few decades. Subsequently many prequalified types of connections proposed by researchers are now being adapted by standard code of practices. However due to practical limitations or lack of adequate steel sections, sometimes engineers need to take initiatives. If not supported by enough knowledge and experience, these initiatives may end up being improper and endanger the structural performance. In Iran and some other countries, due to the difficulties in accessing wide flange sections to be used for columns, it is common to utilise double IPE or INP sections which are put alongside each other and a plate welded to their flanges, this type of built up sections are commonly used as column in many steel structures.

In the bending moment frame systems designed by above mentioned column sections, the beams are typically connected to the column by making use of top and bottom cover plates which welded to the covering plate of the columns. Such connection is widely being considered as rigid connection. In the meantime there is doubt about the rigidity of such connections. It is due to the fact that the beam cover plates are only welded to the column cover plate along its two edges, hence the tensile force imposed by the beam may bend the column cover plate freely between its two welded sides and eventually some degree of rotation can be induced between beam and column.

In order to evaluate the performance of structures built by such details and calculate the degree of fixity of these connections, full scale experiment tests were carried out with above mentioned types of columns and connections in Building and Housing Research Center of Iran [1]. As a result the degree of fixity and the moment-rotation curves for these samples became available and it was evident that some of these connections could not be considered rigid, hence the structures built with these connections must be necessarily re-evaluated.

The important questions which were raised were: what would be the performance level that can be expected with these types of column sections and beam to column connections? and whether they are able to satisfy the life safety level or not?

In this research using the result of the aforementioned experiment and the principles of the performance based design method based on FEMA356 and ATC40 codes the seismic performance of steel structures designed and built with such details were studied.

1 CONNECTIONS OF THE RESEARCH:

1.1 Beam Lines

In order to better understand and be able to recognize the degree of fixity in a connection, the concept of beam lines which was put forward by Basho and Rowan was used. This concept was first used by Sorochinkof and is a useful graphical method to calculate and compare the degree of fixity of different connections[4]

A beam under any given load and the end fixed moment of $M_{fa}$ will follow the following equation:

$$M_a = M_{bf} - 2 \frac{E I}{L}$$  \hspace{1cm}(1)