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OPTIMAL DESIGN OF NEW STEEL CONNECTIONS

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Abstract: The greater part of the European standards, which regulates the structural design of civil and industrial constructions, prescribes the evaluation of different load conditions and different limit behaviors to be imposed to the structure. So, it is usually defined a serviceability condition, characterized by the presence of quasi static loads and moderate intensity seismic actions, and a limit condition, characterized by the presence of suitably reduced gravity loads and full seismic actions. Correspondingly, it is prescribed that the structure exhibits an elastic or a shakedown behavior in serviceability conditions and that the structure does not collapse under limit load conditions, even suffering a limited amount of damage. Consequently, optimal structures must possess adequate stiffness properties in order to ensure the complete usability in serviceability conditions and good resistance and ductility features in order to respect the imposed limit conditions. In this context, steel structures find their ideal application and, actually, they are more and more utilized in new constructions as well as within restoration interventions. The behavior of the structure depends on the utilized steel profiles and on the way they are joined each other. Usually, the connections are designed so as to ensure very high stiffness and resistance to the nodes, so that the elastic and post elastic response of the structure is governed just by the steel elements features. In other words, the elastic and the limit behaviour of the structure are depending on each other being related to the stiffness of the utilized profiles and to their own limit resistance. On the other side, in many cases of practical interest it can be required that structures exhibit an elastic and a limit behaviour independent of each other. With this aim a special connection, called Limited Resistance Rigid Perfectly Plastic Hinge (LRPH), can be utilized, constituted by two parallel bounding plates, connecting the relevant structure elements, with inside a suitably designed sandwich section. In the present paper, an optimization procedure based on a genetic algorithm approach is utilized in order to design LRPH connections according with appropriate prescribed mechanical, kinematical and technological constraints. The obtained results, even if obtained in the limited field of pure bending, are very encouraging and they represent a fundamental starting point for practical applications related to full stress behavior and more complex structures.