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Multicriteria Analysis model for the comparison of different rockfalls protection devices

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In mountain regions roads and railways as well as urbanized areas, can often be endangered by rockfalls and need to be protected against the impact of falling blocks. The effects of rockfall events can be the damage of road, vehicles, injuries or death of drivers or passengers and economic loss due to road closure. The cost of a single car accident can be significant since it can involve the hospitalization of the driver and passengers, the repair of the vehicle, the legal costs and compensation.

The public administrations must manage the roads in order to protect the areas at risk and therefore make choices that take into account both technical and social aspects. The fulfillment of safety requirements for routes in mountainside areas is therefore a multidimensional concept that includes socio-economic, environmental, technical and ethical perspectives and thus leads to issue that are characterized simultaneously by a high degree of conflict, complexity and uncertainty.

Multicriteria Analysis (MCA) is an adequate approach that can deal with these kind of issues. It behaves as an umbrella term since it includes a large series of evaluation techniques able to take into explicit consideration simultaneously several criteria, in order to support the Decision Maker through a rational approach to make a comparative assessment of alternative projects. A very large and consolidated amount of MCA literature exists, in which it is possible to find a wide range of techniques and application fields such as waste management, transport infrastructures, strategic policy planning, environmental impact assessment of territorial transformations, market and logistics, economics and finance, industrial management and civil engineering.

This paper address the problem of rockfall risk induced on a road using the Analytic Hierarchy Process (AHP), a Multicriteria Analysis technique suitable for dealing with complex problems related to making a choice from among several alternatives and which provides a comparison of the considered options.

The developed model takes into account five different aspects of the decision-making process (economic, environmental, design, transport and social aspects) that have been organized according the hierarchical framework of the AHP technique.

The criteria that were identified in the analysis and their weights, in the decision-making process, have been discussed and determined by means of specific focus groups with technical experts in the geo-engineering field. Three different protection devices, usually used for rockfall protection (embankment, shelter topped by rockfall barrier and tunnel), are compared through the AHP method, in a specific “geo” environment to show the feasibility of the method.

The application of the AHP technique, which was performed using the Expert Choice software, allowed the most relevant aspects of the decision-making process to be highlighted and showing how the proposed method can be a valuable tool for public administration. Furthermore, in order to test the robustness of the proposed model a sensitivity analysis was carried out.

The research has an originality value since it focuses on a participative methodological approach thus making the decision process more traceable and reliable.