Disturbance Indicator Benchmark for Urban Bridge Construction

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Summary

European bridges are today in a state of particular concern with over 50% of European urban bridges being more than 40 years old and thus requiring considerable maintenance or possibly even replacement. This means that interventions in the present infrastructure have to be made while ensuring that mobility continues in a safe and consistent manner. Also the (re-)construction of the bridge has to be completed in a sustainable manner with minimum disturbance to the users and local residents. In order to meet the demand for disturbance friendly construction alternatives, a European benchmark of civil engineering projects was created. Ultimately the solution is the use of a Multi Criteria Decision Model (MCDM) linked with the results of the benchmarking assessment in order to weight the selection criteria for the most advantageous construction alternative possible.

Keywords: urban bridge project; resident safety; noise emissions; traffic mobility.

1. Introduction

This paper is based on the PANTURA research project, an EU 7th Framework funded programme, which aims to consider and quantify the disturbance related effects of urban bridge construction [3]. This study creates a European benchmark to illustrate the use of measures against disturbance on three specific indicators: resident safety, noise emissions and traffic mobility. This European benchmark provides insight into the factors causing disturbance, and indicates which measurements are used against these problems. The effects of disturbance can manifest themselves in a number of ways, such as increased stress due to construction noise, accidents due to rerouting of pedestrian and construction traffic, and also financial damages due to decreased mobility surrounding the construction area. Ultimately the input of this benchmark will help the consortium to validate and utilise a Multi Criteria Decision Model (MCDM). This model will enable the selection of sustainable technical alternatives in a new construction project or refurbishment. The client and contractor can hereby decide for the best technical construction alternative at an early stage. The weight for the disturbance indicators used within the MCDM can be based on the benchmark.

2. Case studies and results

The selection of case studies was based on the effort of research partners in their attempt to involve stakeholders of particular civil projects. Research partners working together on this study represented four different EU countries and provided a selection of civil projects covering the Netherlands, Norway, Poland and Spain. Consortium members of the relevant work package were asked to approach stakeholders within their network for cooperating with a particular case study. A weighted representation of both client oriented stakeholders as well as contractor oriented stakeholders was selected. Case studies had to meet several conditions. First of all, the case study ideally had to be a construction of a new bridge or the refurbishment of an existing bridge. Secondly, the project should preferably be located in an urban area. A total amount of 20 case studies from four countries have cooperated in the analysis. Seven cases are located in the

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Netherlands, nine in Norway, two in Poland and two in Spain. Of those who were interviewed, 60% were contractors, 30% were clients and 10% were consultants. From all of the cases, 75% were situated in an urban area while the remaining 25% were situated in an agricultural area or wetland. 90% of the cases are bridge projects and 10% are tunnel projects. One case, 5%, has pedestrians as the target group while the remaining 95% of the projects are meant to be used by motorised traffic. Of the cases, 50% represent a new bridge construction and the other 50% are rehabilitation projects.

3. Benchmark

Case studies listed in the benchmark provide for an overview of measurements that influence a particular indicator and signals what specific measurements are more often applied to EU civil engineering projects than others. This overview can make a valuable contribution in determining the relative weighting of disturbance indicators. It can be hard to decide what indicator should be preferred above others in a MCDM. The benchmark makes it possible to see what number of similar civil projects use a particular measure to diminish the effects on a certain disturbance indicator. The figure recovered from the benchmark, indicating where and how often a single indicator is used in Europe, can guide the decision makers to appoint a certain weight to that indicator in their particular case. It might result in an overview of weights for indicators whereby the indicator with the most applied measures is considered to be the most important in hierarchy. This overview can be used by a client to select a construction alternative, or the client can use this as a starting point and adjust the weight of the indicators to his own preferences.

4. Multi Criteria Decision Model

Selecting the best alternative for a bridge to construct or refurbish can decrease the potential disturbance and therefore improve the sustainability of a project. A MCDM is able to assist in this decision making process. The core essence of a MCDM is enabling the decision makers to rank particular alternatives according to weighted criteria. Making the final decision based on the weighting of multi criteria can give more objectivity and credibility to the decision making process, because all alternatives will be compared according to in advance determined weights. Disregarding the person, time or place the MCDM is completed, as long as the weighting of criteria stays unchanged, the output will be the same. This feature makes the MCDM a standardized and objective tool. It doesn’t imply that the input of alternatives in scoring indicators is not subjective though.

5. Conclusion and Recommendations

Both the benchmark and the application in the MCDM have proved to be helpful for clients and stakeholders to facilitate the selecting of the best construction or refurbishment alternative possible. The research consortium of PANTURA tested the MCDM in a real life case study. The model was tested for selecting the best construction alternative based on weighted indicators. A selection had to be made between a conservative and a contemporary refurbishment method (FRP strengthening technology). By this exercise, the use of benchmark and functioning of the MCDM is validated. From our point of view it illustrates an objective approach to come to a credible selection of alternatives.

In the future the benchmark can be extended by making use of the information of cases performing the MCDM, ultimately resulting in a larger and more reliable European benchmark. This leads to a benchmark of substantial size wherein a sub selection of cases can be made to use the input that is more similar to the case in reality (refurbishment, steel bridges, pedestrian crossings etc.) and this again contributes to a more accurate MCDM. This way the benchmark and the MCDM can ‘live’ in symbiosis and improve each other.