



## 2012 International Symposium on Safety Science and Technology Risk assessment on falling from height based on AHP-fuzzy

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### Abstract

In all the construction safety accidents, the high falling accident is the most serious construction accident of five big hurts which are threatening building workers. Risk assessment is the important means how to prevent and control falling from height accident. Based on "human - machine - environment - Management" complex system, the risk assessment index system about 4 major categories and 23 sub-categories include the quality of factors of production personnel and the production equipment factors and the environmental conditions factors and the safety management factors was established. The AHP-Fuzzy evaluation model of risk assessment of falling from height and weight sets were established based on AHP and fuzzy comprehensive evaluation method. The risk assessment example was given and the results were conformed to reality.

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*Keywords:* risk assessment; analytic hierarchy process(AHP); fuzzy evaluation; falling from height

### Nomenclature

$\omega$	the corresponding feature vector
$CI$	consistency index
$CR$	consistency ratio
$F$	the final results of AHP-Fuzzy comprehensive evaluation method
<i>Greek symbols</i>	
$\lambda_{max}$	is the biggest characteristic root of R

### 1. Introduction

At present, the construction industry has become our country all the industrial sector of the most dangerous after mining industry [1]. Moreover, falling from height accident caused casualties and economic loss is the biggest in building production safety accident. Because of high incidence, its danger is the head of in construction industry "five hurts" accidents list [2]. According to *Architectural Production Safety Accidents in the First Half of Presentations in 2010* published by *Ministry of Construction of Housing and Urban-Rural, in 2010*, falling from height accident of China's total 103 up, accounting for building safety accidents of the total number of 48.13% [3]. For example, an accident had happened in coastal garden's 24-27 building project in March 26, 2010, Foshan, Guangdong, and led to two deaths. In the same year on May 9, an accident had happened because of the hospital, different newly-built project in HuanRen county, Liaoning province, and four persons were killed.

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So falling from height accident prevention and control is an important problem that should be solved in construction, the significant solution is falling risk assessment. At present many scholars had done quite a bit of research by using the fault tree method and analytic hierarchy process. Literature [4] used the fault tree analysis, the structural importance of falling from height accident basic events was determined, in the same time, calculated the key importance degree and the probability of occurrence, but, the probability of the basic events was too general. According to characteristics of falling from height accident in construction process in Literature [5], AHP was used to divide risk of falling from height into three subunits: factors of operators, objects and management. Next, risk factors were analyzed in detail and description in each subunit, and the risk assessment index system was built, its deficiency was without considering influence come from environment. Another literature [6], with falling from height accident as research object, relative importance ranking of vector of each factors which will cause the accident happened was got, then, based on the definition of brittle stimulate degrees, brittleness analysis of accident was made, and brittle sources were obtained. Deficiency is not given out safety level of this project. Due to the AHP method is a qualitative and quantitative method that processing and express men's subjective judgment with quantity forms [7], it widely applied in oil, chemical and mining fields and etc. However, its disadvantage is lack of unified and specific index quantification method during the overall evaluation when used AHP. Fortunately, the fuzzy comprehensive evaluation method can just make up it [8].

In this paper, as risk of falling from height for the research object, the index system was built by AHP-Fuzzy comprehensive evaluation method. It found that evaluation results and practical safety conditions conclusion is consistent through the engineering application. There is great significance to study the safety conditions working at height based on AHP-Fuzzy.

## 2. AHP-fuzzy comprehensive evaluation method

Using AHP-Fuzzy comprehensive evaluation method, the first step is decomposing problems into each composing factors, then put these factors formed recursive class times relation structure by dominating relations. Third, ensure the hierarchy of the relative importance of various factors by the fuzzy consistent judgment matrix. At last, determine general sorting of relative importance of general decision-making plan and evaluation results after composing judgment of policymakers and expert grading. The procedure is shown in Fig 1.

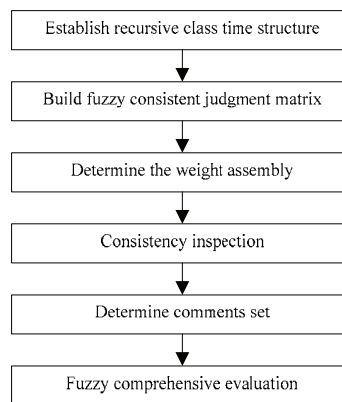


Fig. 1. Steps of AHP-Fuzzy comprehensive evaluation method.

### 2.1. Establish recursive class time structure

Using AHP analyze the relations of each factor in system, then establish recursive class time structure, and build the hierarchical structure model. In this situation, complex problems are made up of several elements. According to its property, these elements divided into groups, forming different layers. A certain hierarchy elements are the criterion to the next level of certain elements within a dominant, which is affected by a front layer of element the domination of the victors.

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