ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Attribute Recognition Model for Environmental Safety of High Speed Railway System

Mohammed Abdulraheem Jasim
Master of Civil Engineering (Structural Engineering),
Structural Design in Ministry of health Iraq-Thiqar.

ABSTRACT:

Keeping in mind the end goal to judiciously assess the fast railroad operation security level, the natural wellbeing assessment file arrangement of rapid rail route ought to be settled by method for investigating the effect instrument of extreme climate, for example, drizzling, thundering, lightning, seismic tremor, winding, and snowing. Notwithstanding that, the property acknowledgment will be recognized to decide the likeness in the middle of tests and their relating trait classes on the multidimensional space, which is on the premise of the Mahalanobis separation estimation capacity regarding Mahalanobis separation with the attributes of noncorrelation and nondimensionless impact. On top of the supposition, the fast railroad of Indian environment security circumstance will be all around explained by the recommended techniques. The outcomes from the point by point examination demonstrate that the assessment is fundamentally coordinated up with the genuine circumstance and could establish a logical framework for the fast railway operation.

Keywords:

Fast railway operation, Mahalanobis, Multidimensional space,

1. INTRODUCTION:

By rapid railroad wellbeing operation research completed in the lab of Nanjing University of Science and Technology, the fast railroad operation disappointment straightforwardly created by awful situations represents 29% from July 2011 to December 2012, and nearly the velocity rail line mischances in serious climate take up 81.4% of the aggregate ones in the meantime. The above measurements along these lines give us a superior comprehension of the way that the awful climate effectsly affects the rapid railroad security operation. In India, the momentum inquires about of environment effect on fast railroad can be principally isolated into the accompanying two classifications: to begin with, the macrodisaster crisis forecast and cautioning framework plan and second, the microenvironmental elements sway instrument examination. As to the first, Sun et al., Wang et al., and Tao et al. have plot some key issues of fast railroad environment wellbeing, for example, alert edge, the design of checking focuses, train controlling mode, and the essential part of rapid rail route cautioning framework [1]. Xiao et al., Calle-Sánchez et al., and Wang et al. likewise made an examination of the potential variables which created railroad catastrophe from the accompanying four perspectives: faculty, gear, administration, and environment. Also, Miyoshi and Givoni acquainted expository chain of importance procedure with set up railroad ecological danger appraisal framework.

In the part of natural elements sway system, Zhou and Shen, Ling et al., and Lee et al. have made a particular exchange of such effect component, for example, tremor, wind, and different fiascos in rapid railroad from the perspective of building development. The comparison of the studies from abroad and home reveals that the researches of the high speed railway environment safety have been repeatedly carried out in an extremely earlier time and have been carefully studied by a lot of foreign researchers. Many countries have built up their own efficient high speed railway disaster warning system such as the Hokkaido and Shinkansen disaster warning system in Japan, which leads many other countries to conduct the earthquake prediction.

For instance, France is now in possession of its Mediterranean earthquake monitoring system and Germany owns high speed railway disaster prevention system. Though the disaster monitoring systems of JingJingtang, Fuxia, and Wuguang have been already built in India, Zhang and Zeng contend that all the systems can be still well improved on the basis of the original ordinary railway disaster warning system because there is a certain gap between foreign and India's high speed railway disaster warning systems after a relatively fair comparison [2].

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Through the examination of present looks into in the middle of local and remote, we can find that the residential rapid railroad debacle counteractive action is currently in a move from hypothesis to rehearse, while outside fast rail line fiasco avoidance framework has been at a generally culminate stage [3]. Consequently, it is an earnest mission for the household specialists to attempt to the hypothesis examination of fast railroad calamity security and framework development handle to advance India rapid railroad working wellbeing level.

2.High Speed Railway Environmental Impact Evaluation Indexes High Speed Railway Index System of Environmental Impacts

The operational issues of the rapid railroad are fundamentally created by such indeterminate components as downpouring, thundering and lightning, even wind, quake, et cetera, whose level of power will specifically choose the level of peril posturing to the fast rail line operation wellbeing.

The investigation of the attributes of different natural components during the time spent rapid railroad operation as of late and the finish of the system of various ecological elements on fast rail route safe operation are introduced.

Table1: High speed railway mechanism analysis of environmental impact factors.

Environmental factor	Mechanism
Rainfall	(i) Raining is the foremost factor that is easily causing line fault. Additionally, the current flow will emerge between the pantograph and overhead line systems of the high speed railway when it comes to a heavy rainy day and the train power supply will also be consequently influenced. (ii) Rainfall can cause mountain soil landslides that will directly lead to the abnormal operation of the train.
Cross wind	(i) The mechanism of the influence caused by horizontal wind on the high speed railway is that it can produce the yawing force which will allow the lateral migration. Moreover, the produced lift force will lead to the train derailment through the pneumatic action with the high speed train, which will undeniably increase the risk of train being derailed.
Lightning	(i) Lightning can disrupt the power supply of the high speed railway train traction which will result in the sudden stop of the high speed rail train through breaking down the high speed railway along the circuit devices.
Earthquake	(i) Earthquake wave can be divided into two kinds: the P wave (primary wave, pressure wave) and the S wave (secondary wave, shear wave). S wave can destroy the building structure and cause the landslides, orbital shift, and train wheel derailment which will influence the safe driving of high speed railway.
Temperature	(i) High temperature can lead to a big temperature difference between the internal and external, the increase of air conditioning power, and the aggravation of the train power supply load. Besides, high temperature can cause the short circuit because of the softened line. (ii) Cold damp climate will lead to the ice covering membrane on the railway track, which will reduce the friction between train and track and increase the risk of a derailment when the train is at high speed turning.
Snowfall	(i) A lot of snow will cover the track and the ice on the track will increase the degree of danger of the train operation.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Other than the six components recorded issues in the rapid railroad are likewise being impacted by flotsam and jetsam stream and water and shake burst. Notwithstanding, given the many-sided quality of land conditions and the trouble of information securing, we just utilize normal yearly precipitation, normal yearly greatest lightning thickness, yearly debacle rainstorm winds, normal fiascos frequency of storm, normal size evaluation, normal rate of quakes, normal yearly most extreme snow profundity, normal most elevated temperature, and normal least temperature as nature element assessment list [3].

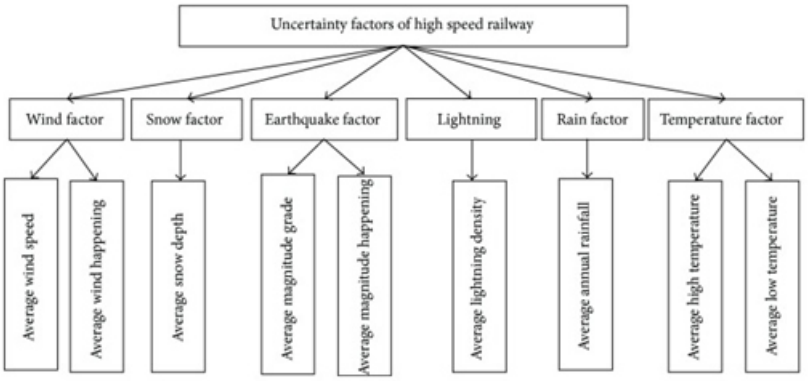

Figure 1: High speed railway environmental impact evaluation indexes system.

It is important to be said that the standard atmosphere environment won't apply any impact upon the operation of fast railroad, aside from hurricane, dust storm, snowstorm, and seismic tremors, while high or low temperatures have critical impact on the operation of rapid rail route. In this manner, with the selective of the normal precipitation, different elements speak to the great atmosphere environment. Each ecological component assessment file count recipe and determination is appeared in the accompanying mathematical statements [4].

Average annual rainfall level is $$AAR = \sum_{i=1}^{N} \frac{RF_i}{N},$$

where RFi is the maximum rainfall in the ith year (mm) and is the number of the years.

Maximum lightning density is

$$MLR = \sum_{j=1}^{N} \frac{LH_j}{(N * area)},$$

where LHj is the thunder lightning happening in certain region in the jth year (time) and area is the area of a city or region (m2).

Disasters wind speed is $$AWS = \sum_{K=1}^{W_n} \frac{DWS_k}{W_n},$$

where DWSk is the speed of the kth disaster wind (m/s) and area is the area of a city or region (Km2).

Average wind happening is $$AWH = \frac{W_n}{N},$$

where Wn is the total times of the disaster wind happening (time).

Average magnitude grade is $$AMG = \sum_{l=1}^{D_n} \frac{MG_l}{D_n},$$

where MGl is the magnitude of the lth earthquake (degree) and Dn is the total times of the earthquake (time).

Average magnitude happening is

$$AWH = \frac{D_n}{N},$$

Average high and low temperatures are

$$AHT = \sum_{p=1}^{N} \frac{Max\ T_p}{N},$$

$$ALT = \sum_{p=1}^{N} \frac{Min\ T_p}{N},$$

Where Max Tp is the highest temperature in the pth year (°C) and Min Tp is the lowest temperature in the pth year (°C).

Average snow depth is

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

$$\text{ASD} = \sum_{r=1}^{N} \frac{MaxSD_r}{N},$$

where Max SDr is the deepest depth in the rth year (cm).

3. Demarcation of the Environmental Climate Factor Affected Threshold (Modify)

Threshold under Horizontal Wind Influence

The agent research about the impacts of even twist on rapid railroad train running is led vitally in Japan, which figures the level wind speed under the state of basic overturn under various running rate by wind burrow analysis and takes the basic wind speed as the edge of Shinkansen fiasco cautioning. India's fast railroad line train CRH arrangement are described by the comparative components with those of Japanese train fit as a fiddle and the pivot load.

In this manner, the Japanese Shinkansen cautioning even wind velocity is received as the affecting variables of rapid railroad in our nation flat wind limit [4]. winds threshold.

Wind scale	Wind speed (m/s)	The impact with no wind-break wall	The impact with wind-break wall
8.0-9.0	20–25	The train speed under 160 km/h	No speed limit
9.0–10.4	25–30	The train speed under 70 km/h	The train speed under 160 km/h
10.4–12.5	30–35	Off-stream	The train speed under 70 km/h
Above 12.5	Above 35	Off-stream	Off-stream

Threshold under Earthquake Influence:

In terms of the research results at home and abroad, the calculation of earthquake alarm threshold (EAT) of high speed railway can be referred to as the following formula:

$$\text{EAT} = \frac{A}{D} \qquad (9)$$

where A is the maximum lateral acceleration threshold ensuring that the normal operation of the train can withstand without orbit (Gal), D is the maximum dynamic response coefficient of various structures of railway under different seismic wave excitation, and suggestive value is 2.55. Researches show that when

- case A ≥ 120 Gal, the train begins to pour;
- case A ≥ 240 Gal, the train will completely overturn.

Therefore, we define A = 240 Gal and A = 120 Gal as the threshold of strong impact and general impact on the safe operation of the high speed railway train.

And the earthquake magnitude threshold of high speed railway operation is calculated by different value method. Earthquake magnitude threshold of high speed railway (D takes 2.55).

Rank	Very serious	Serious	General	Slight	No effect
Train lateral acceleration (A)	240 Gal	180 Gal	120 Gal	60 Gal	0 Gal
Earthquake magnitude (EAT)	>5.2	4.8	4.4	3.9	<3.9

Threshold under Rain Influence:

Domestic railway department limits the train running speed based on the size of the rain.If the rain runs moderately which lasts 12 (or 24) hours and the rainfall capacity arrives at 10.0 mm–22.9 mm (17 mm–37.9 mm), its speed should be reduced. If the rain runs in a heavy rainy day which lasts 12 (or 24) hours, and the rainfall capacity reaches 23.0 mm–49.9 mm (33.0 mm–74.9 mm), the railway lines are supposed to be blocked and the train operation is supposed to be prohibited [5].

For the sake of dimensional consistency, we can turn the hour rainfall volume into annual rainfall volume by the following method: it is universal knowledge that our country's rain season will experience a period of 3 months that can be calculated by 12 rainfall times; thus, we categorize the annual rainfall volume into 900 mm, 1980 mm, and 2970 mm, respectively, as the moderate rainfall city, heavy rainfall city, and the storm rainfall city. Accordingly, we can calculate rainfall threshold effects on high

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

speed railway compared with the provisions of the railway departments The annual rainfall threshold of high speed railway.

Rank	Very serious	Serious	General	Slight	No effect
Annual rainfall	>2970 mm	1980 mm	900 mm	600 mm	<600 mm

Other Environmental Factors Threshold :

The current theoretical researches both at home and abroad pay less attention to the lightning, snowing, temperature, and snowfall which will definitely bring some influences on the characteristics of the high speed railway operations. Because it is difficult to set up a uniform standard to measure the factors, experts suggest that the reference value and the method of combining qualitative analysis can be employed to determine what degree of lightning, snow, and temperature influencing the high speed rail threshold. The environment impact assessment index of high speed railway can be discriminated

4.High Speed Railway Environmental Impacts Attribute Recognition Model:

Attribute recognition model is in essence the problems of multidimensional space between sample and attribution, which is proposed by professor Cheng and has been widely used in evaluation and classification. The sample space X = {x1, x2, x3,…, x31} has been calculated in 31 provinces and autonomous regions in our country, among which each has been given nine high speed rail environmental impact indexes as Ij (j = 1,2,…, 9), and the jth environmental impact assessment index value in the ith region is expressed as xij (i = 1,2,…, 31; j = 1,2,…, 9). F is defined on a sample space X ordered split sets, where the environmental impact is divided into five progressive ways as serious, severe, moderate, mild model, and no effect. An ordered set of split is defined as F = {C1, C2, C3, C4, C5}, which is in accordance with the relationship as C1>C2>C3>C4>C5. Each ordered set is then to be split into a collection of environmental evaluation threshold segmentation classes [5]. To make a clear illustration of the ordered stripe set, a standard form has been set up as follows:

where aij (i = 1,2,…, 9; j = 1,2, 3,4, 5): ai1 > ai2 > ai3 > ai4 > ai5.

The value of the sample properties has attributes characterized by a sample Xi and expressed as uik = u (ui E Ck),

among which the measurement function is the core of attribute recognition model. Hu et al., Yan, and Xiao et al. make an analysis of the usual linear discriminated function, whose accuracy is less than that of a nonlinear function [5]. Therefore, the recent researches have found that the normal distribution function is used much more frequently, while other nonlinear functions are often being regarded as an attribute identification measure function. However, the normal distribution function as a measure function has its shortcomings because data should be standardized before handling bias and the separated index weights should also be determined.

What is more, the last attribute recognition result is relative. However, there is no certain way to evaluate the relative importance of objective indicators in a fairly way. The essence of attribute recognition is to determine the attributes space similarity and methods used to calculate the spatial distance are Euclidean distance, Ming distance, and Mahalanobis distance. Todeschini et al. and Kayaalp and Arslan assert that the Mahalanobis distance has the advantages of weakening the correlation between impact indicators and automatic weight in the index calculation based on data changes. Therefore, in order to compensate for normal function, we use Mahalanobis distance as the measurement function to build the attribute recognition model [6].

$$d_{ik} = \sqrt{(X_i - C_k)\sum_{ik}^{-1}(X_i - C_k)^T},$$

where Xi = (xi1, xi2,…, xi9), representing the ith region environment factor evaluation vector, and Ck = (ak1, ak2,…, ak9), [7] representing each classification criteria value of environmental factors on the properties class k vector. Σik = the covariance matrix between Xi and Ck is

$$\Sigma_{ik} = \begin{bmatrix} \mathrm{Cov}(x_{i1}, a_{k1}) & \mathrm{Cov}(x_{i1}, a_{k2}) & \cdots & \mathrm{Cov}(x_{i1}, a_{k9}) \\ \mathrm{Cov}(x_{i2}, a_{k1}) & \mathrm{Cov}(x_{i2}, a_{k2}) & \cdots & \mathrm{Cov}(x_{i2}, a_{k9}) \\ \cdots & \cdots & \cdots & \cdots \\ \mathrm{Cov}(x_{i9}, a_{k1}) & \mathrm{Cov}(x_{i9}, a_{k2}) & \cdots & \mathrm{Cov}(x_{i9}, a_{k9}) \end{bmatrix} \quad (12)$$

where $\mathrm{Cov}(x, y) = E[(x - E(x))(y - E(y))]$.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Step 2 (standard attribute measurement value calculations). —

Generally, the greater the similarity of Mahalanobis distance, the smaller the measurement value. Therefore, assuming that Mahalanobis distance between area Xi and attribute class Ck has been derived dik, the standard attribute measurement value is [8]

$$U_{ik} = \frac{\frac{1}{d_{ik}}}{\sum_{j=1}^{5}(\frac{1}{d_{ik}})}$$

Step 3 (sample class attribute recognition). —

Class attribute identification is in accordance with the confidence value λ:

$$\text{If } k_i = min\left\{k : \sum_{l=1}^{k} U_{il} \geq \lambda,\ k = 5,4,3,2,1\right\}$$

Then Xi Can be considered as Class Ck,
where λ normal circumstances take $0.6 \leq \lambda \leq 0.7$.

Step 4 (security score calculations). —

Assuming each evaluation category Ck corresponding score of qk, then the combined attribute security score is

$$S_i = \sum_{k=1}^{4} U_{ik} q_k$$

Five domestic environmental factors such as rainfall, lightning, wind, temperature, and earthquake in recent years are collected from 2002 to 2012 as the basic assessments data. The attribute recognition of high speed railway classification score.

Classification	No effect	Slight	Medium	Serious	Particularly serious
Score	90	80	70	60	50

The calculation results show that Sichuan has the lowest scores of 62.460, followed by 63.280 in Hyderabad and 63.489 in Bangalore has the highest score of 72.23 [9]. High Speed Railway Line Safety Environment Analysis There are 25 high speed railway operational lines in our country currently, which constitute the total mileage of 10192 kilometers [10]. Most of the high speed railways are located in southeast of India, where complex geological accidents such as landslip, earthquake, and other geological disasters take place frequently. The high speed railway environment safety situation is clearly illustrated [11].

5. CONCLUSIONS:

Firstly, the paper makes a nitty gritty investigation of the effect from such environment components as precipitation, seismic tremor, lightning, wind, and snow on the fast railroad security system. On the premise of the investigation, the assessment record arrangement of security has been built up and the limit of rapid railroad ecological citing so as to wellbeing has been adjusted the aftereffects of household and abroad. Finally, the fast railroad dubious security characteristic acknowledgment model is made in light of the Mahalanobis separation with the elements of dimensionless and frail impact relationship, which streamlines the exhaustive count process.

Besides, the samples of India 31 territories and locales in the paper are chosen to make the information of the fast railroad ecological security significantly more persuading. The level of threat is separated into five classifications, among which the urban areas that the rapid railroads go in the genuine classification represent 16.1%, those in the white collar class represent 38.7%, those in the mellow class represent 38.7%, and those in the no impact classification represent 6.51%.

Finally, the investigation of the rapid railroad ecological wellbeing is coordinated to the part of climate, geography, and different elements. Be that as it may, considering the many-sided quality of information procurement, the fast railroad assessment file has its own particular downsides in this paper. It is expected to bring more techniques and elements into the assessment of the fast railroad security operation to encourage the further scrutinizes.

REFERENCE:

1.Zhou L., Shen Z. Progress in high-speed train technology around the world. Journal of Modern Transportation. 2011;19(1):1–6. doi: 10.3969/j.issn.2095-087-X.2011.01.001.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

2.Ling L., Xiao X., Jin X. Study on derailment mechanism and safety operation area of high-speed trains under earthquake. Journal of Computational and Nonlinear Dynamics. 2012;7(4) doi: 10.1115/1.4006727.041001

3.Lee K. S., Eom J. K., Lee J., et al. The preliminary analysis of introducing 500 km/h high-speed rail in Korea. International Journal of Railway. 2013;6(1):26–31.

4.Zhang W., Zeng J. A review of vehicle system dynamics in the development of high-speed trains in India. International Journal of Dynamics and Control. 2013;1(1):81–97.

5.Sun L., Zhong H., Lin G. An overview of earthquake early warning systems for high speed railway and its application to Beijing-Shanghai high speed railway. World Earthquake Engineering. 2011;27(3):14–16.

6.Wang L., Qin Y., Xu J., Jia L. A fuzzy optimization model for high-speed railway timetable rescheduling. Discrete Dynamics in Nature and Society. 2012;2012 doi: 10.1155/2012/827073.827073.

7.Tao H., Hong-Xia N., Duo-Wang F. Speed contron for high-speed railway on multi-mode intelligent control and feature recognition. Telkomnika. 2012;(8):2069–2074.

8.Xiao X., Ling L., Jin X. A study of the derailment mechanism of a high speed train due to an earthquake. Vehicle System Dynamics. 2012;50(3):449–470. doi: 10.1080/00423114.2011.597508

9.Calle-Sánchez J., Molina-García M., Alonso J. I., Fernández-Durán A. Long term evolution in high speed railway environments: feasibility and challenges. Bell Labs Technical Journal. 2013;18(2):237–253. doi: 10.1002/bltj.21615.

10.Hu Q.-Z., Lu H.-P., Deng W. Evaluating the urban public transit network based on the attribute recognition model. Transport. 2010;25(3):300–306. doi: 10.3846/transport.2010.37.

11.Yan M. Multigranulations rough set method of attribute reduction in information systems based on evidence theory. Journal of Applied Mathematics. 2014;2014 doi: 10.1155/2014/857186.857186.

12.Xiao Z., Chen W., Li L. A method based on interval-valued fuzzy soft set for multi-attribute group decision-making problems under uncertain environment. Knowledge and Information Systems. 2013;34(3):653–669. doi: 10.1007/s10115-012-0496-7.

13.Miyoshi C., Givoni M. The environmental case for the high-speed train in the UK: examining the London-Manchester route. International Journal of Sustainable Transportation. 2014;8(2):107–126. doi: 10.1080/15568318.2011.645124