Modelling of Road Accidents Impact of Traffic Parameters

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Abstract- *The issue of road accidents is an increasing problem in developing countries. This could be due to increasing road traffic/vehicle occupancy.This has been increasing over years. Regulating traffic on roads is an important task. There by reducing accidents in accident prone zones. The accident was drastically increased over a decade from 4% to 31%. This is a alarming issue. The analysis and identification of such road accident prone zones is essential to reduce the accidents. A model was developed based on intersection parameters and no. of accidents by regression analysis*

The huge financial and societal cost associated with traffic crashes and the fact that more than half of them occur at junctions ,revealed the need for further research in the field of junction

In addition, sensitivity analysis was performed in order to better understand the impact of selected parameters to the total number of crashes. The analysis has led to several conclusions such as that angle and left turn collisions have much higher probability of occurrence at junctions and that crashes which occur at junctions are much more probable for low and medium volumes compared to no-junctions

I. INTRODUCTION

The issue of road accidents is an increasing problem in developing countries. This could be due to increasing road traffic/vehicle occupancy. This has been increasing over years. Regulating traffic on roads is an important task. There by reducing accidents in accident prone zones.The accident was drastically increased over a decade from 4% to 31%. This is a alarming issue. The analys is and identification of such road accident prone zones is essential to reduce the accidents. The factors influencing such accidents are to be analyses for remedies. Using regression Models, factors influencing road accidents have analyzed using SPSS model. The study are a selected is part of Hyderabad. Telangana (GHMC) with heavy traffic. The objective of the paper is to review relation between accident per year and intersection Parameters. To develop prediction models and test their validity. To suggest improvement measures to prevent road accidents and to derive a model for accident parameters.

There are many types of road accidents and it is important to seek prompt advice from a solicitor who understands your type of case.

Pedestrians

- Pedestrians must be given the right of way by motorists.
- I f you were hit by a car - even if it didn't stop – you may be able to make a claim.

Motorcyclists

- Motorcycles represent approximately 1% of the traffic on our roads in the UK but they account for 18% of all deaths and serious injuries.
- Motorcyclists are vulnerable drivers and a collision often leads to very serious injuries.

Passengers

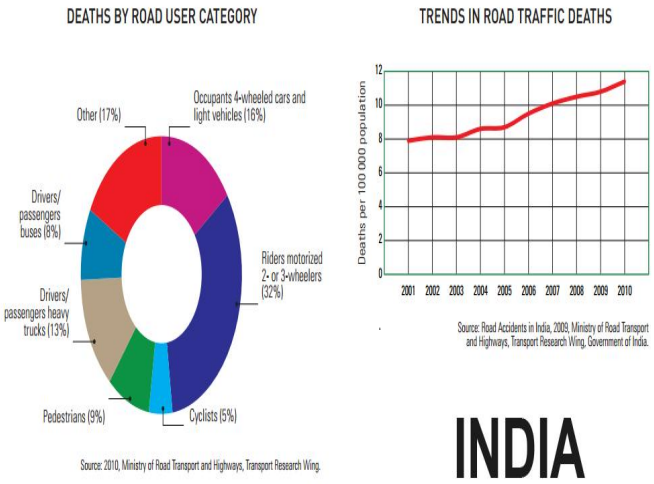
- You may have been a passenger on public transport, in a taxi or in a private vehicle such as a car, van, bus or coach.

Drivers

- If you were the driver of a car your claim would be against the person who was responsible for the accident - perhaps another driver was driving without due care and collided with you.

Cyclists

- Cycling can be good fun, great exercise and an enjoyable leisure activity. However cyclists are very vulnerable on the road and have little protection if they are involved in any type of collision.



shows the deaths by road user category

Five important points for you to consider

1. Get the best evidence you can to help your claim

To make a successful claim for compensation it has to be proved that someone else was to blame for your accident and the injuries you are suffering from. Obviously, the stronger your evidence the stronger your claim.

2. Timing can be vital

You should seek legal advice as soon as possible - action needs to be started within three years of the date of the accident.

3. What if the driver wasn't insured or didn't stop?

If you have been injured by someone who was uninsured, or who left the scene of the accident without stopping and giving their details, there are still ways we can help you.

The Motor Insurance Bureau (MIB) is an organization that helps members of the public who have been affected by uninsured or untraced drivers.

4. How much compensation might be awarded?

The circumstances of road accidents are often similar, but the effect on the individual is unique and this makes every compensation claim different.

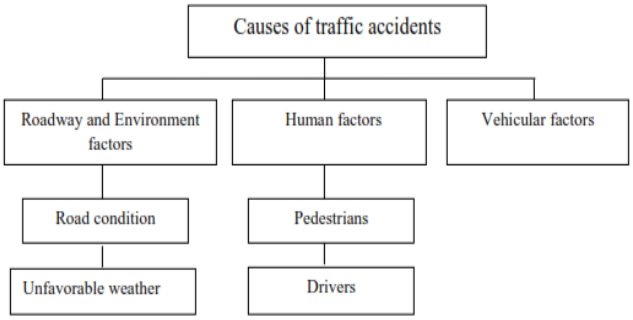
Compensation is awarded for pain, suffering and the inability to do things now that you could do before the accident. For example the inability to work, to drive, to shop, to play sport, to care for yourself.

5. What about state benefit claims?

You may be entitled to disablement benefit and/or other State Benefits. Thompsons can advise you on this as, of course, can your local Department of Work and Pensions (DWP) office. Any such claims are made separately to your claim for compensation.

MAJOR CAUSES OF ACCIDENTS

In developing countries and especially Arab countries without exception, the problem of traffic accidents is very serious and it's become more difficult to control.



Causes of Road Crashes

There are three basic factors that impact on road safety. In increasing importance order they are:

- In efficient geometric characteristics.
- Poor study, construction and placement of roadside signage.
- Poor traffic management.
- Lack of or insufficient road lighting.
- Insufficient traffic control and signage during road construction.

Junction Safety

Junctions are important are a types of road network, where a significant number of traffic crashes occur(Leeetal.,2004; IATSS, 2005; NCSA, 2005; ERSO, 2006; Guoet al., 2010; Haleem etal., 2010; Youngetal., 2012; Mitraand Washington, 2012; Ferreira and Couto, 2013). This is because junctions are locations where two or more roads cross each other with high number of conflict points (NHTSA, 2010). The number of crashes occurring at junctions is relatively high considering that they are as mall portion of the highway system. Many studies have been done to examine the effect of junctions.

II. LITERATURE REVIEW

Neumann and Glennon(1982) described a theoretical model that relates accident on crest curves to available sight distance. The development of this model was not based on accident data, rather the model reliednintuitively logical relationship and engineering judgment. Highway designers to systematically evaluate the cost effectiveness spot improvement of location with deficient SSD's.

Charles Vzegeeretal(1995) developed Accident Relationships of Roadway Width on low-Volume Roads Horizontal curves represent a considerable safety problem on rural two lane highways. A1980 study estimated that there are more than 10 million curves on the two-lane highway system in the U.S. Accident studies further indicated that curves experience a higher accident rate than dotangents, with rates that range from one and a half to four times higher than similar per haps be more important in light of improvements being made related to resurfacing, restoration, and rehabilitation projects, commonly known as the 3 Rprogram. Using this model form, the variable indicating spiral transitions was also found to be statistically significant, and the basic estimated model for total accident rate was given by:

Luis F. Miranda-Morenoetal(2005) developed Alternative Risk Models for Ranking Locations for Safety Improvement. The authors compare the performance and practical implications of these models and ranking criteria when they are used for identify in ghazardous locations. This research in vestigates there lative performance of three alternative models: the traditional negative binomial model, the heterogeneous negative binomial model, and the Poisson log normal model.

HenryC.Brownetal(2006) considered the effects of access control on safety on urban arterial streets. Access control techniques are used to improve traffic performance and safety on highways. One important benefits of access control is improved safety. For a quantitative assessment of the benefits of access control on safety, impact models are needed to predict crash frequencies based on the geometric and access control characteristics of the segments. The objective of this research was to develop regression models to predict crash frequencies on urban multilane arterial segments. To develop these models, data were collected on geometric and access control characteristics of the segments and the number of crashes on the segment by severity type. Negative binomial regression models were developed to predict the total number of crashes, number of property-damage 0 only crashes, and number of fatal and injury crashes.

Intersection– Related Crashes at Signalized Intersections

As most of the signalized intersections are located in the urban environment which includes all multi modal movements, the distinction between signalized and unsignalized is necessary. One of the first studies in this area was executed by Chinetal., (2003).The authors developed a random effect negative binomial model(RENB) to identify factors that affect intersection safety. The model examined the relationship between accident frequencies and the geometric, traffic and regulatory control characteristics of52 four-legged signalized intersections from 1992-1999. Results depicted that the total approach volumes, the number of phases per cycle, the uncontrolled left-turn lane and the presence of a surveillance camera are among the variables that significantly affected traffic crashes.

Intersection– Related Crashes at Unsignalized Intersections

One of the first studies in this area was execute dyThompsonin1978.The author used anun certainty model a same a sure of safety value in order to obtain quantifiable results. The method was used to compare differences in the priority rules in New Zealand, before and after the Traffic Regulations alteration in 1977.

The results illustrate that any increase in the level of control tended to cause more vehicle accidents and fewer pedestrian accidents. Thus, increasing the control level at Unsignalized intersections is not a sure remedy to hazard ous urban intersections.

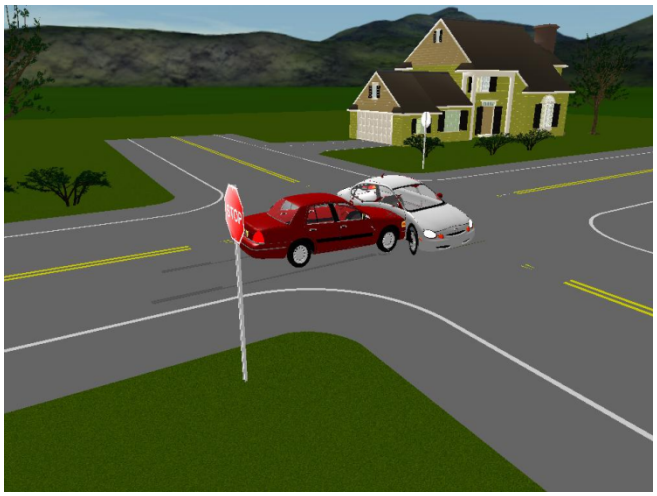


Fig : shows accidents at Unsignalized intersection

Intersection – Related Crashes at Urban Intersections

The literature review carried out in this field revealed that the research was limited until recently (Ghamdi, 2003). It should also be noted that according to official traffic accident statistics, urban intersections are problematic locations in

many urban cities around the world (Ghamdi, 2002, Gomes 2012). Thus, in the literature review section, there will be a section about intersection – related crashes at urban intersections.

One of the first studies in this area was executed by Hakkert et al., in 1978. Study area was 250 urban and interurban intersections in Israel. A Poisson model was developed which estimates the expected number of accidents at individual intersections from traffic flows on the approaches. Vehicle exposure was used as the basis for this estimation. The exposure was calculated through the sum of the products of flow at the 24 points where vehicle paths cross or merge.

Finally, Bhat et al., (2013), proposed a count data modelling estimation approach with endogenous covariates in order to predict crash occurrences at urban intersections in Irving, Texas. The sample was obtained from the Texas Department of Transportation (TxDOT) crash incident files for 1032 urban intersections in 2008. The study highlights the significance of taking into consideration endogeneity effects in count models. The results reveal that intersections with a crest approach, intersections that are on frontage roads and flashing light-controlled intersections are projected to have 2.5-3 times more

Intersection – Related Crashes at Rural Intersections

Until now, traffic safety literature mostly has focused on roads in built-up areas, major roads as for traffic and by extension urban intersections. However, limited literature has been done in rural intersections besides the fact that in rural intersections and especially in rural non-signalized intersections (with mixed traffic) the crash and fatality rate is comparatively high (Wegman and Aarts, 2006; Jaarsma et al., 2011; Burgess, 2005; Bao et al., 2009). Thus, this limited research was included in the literature review section.

Traffic Crashes at Junctions

This section was decided to be included in the literature review because the study area in those research papers contains mixed road environment (urban & rural areas). In addition, junction crashes include not only intersection crashes, but also intersection related crashes and interchange crashes (railroad crossings, ramps, etc.) as well. In the research center of Finland, Kulmala in 1994 explored the effects of road measures implemented at 623 main junctions for the years 1984-1986. The number and type of accidents were studied at each junction both before and after the implementation of the measure. The effects of the measure were determined by comparing the observed number of accidents after the measure with the number that would have been expected to occur at the junction ifthe measure had not been implemented. The expected number of accidents was calculated based on accident prediction model. Outcomes show that road lighting, STOP signs, signal control, and lower speed limits were found to decrease the number ofaccidents. Additionally, road widening and additional lanes for turning vehicles did not seem to affect junction safety.

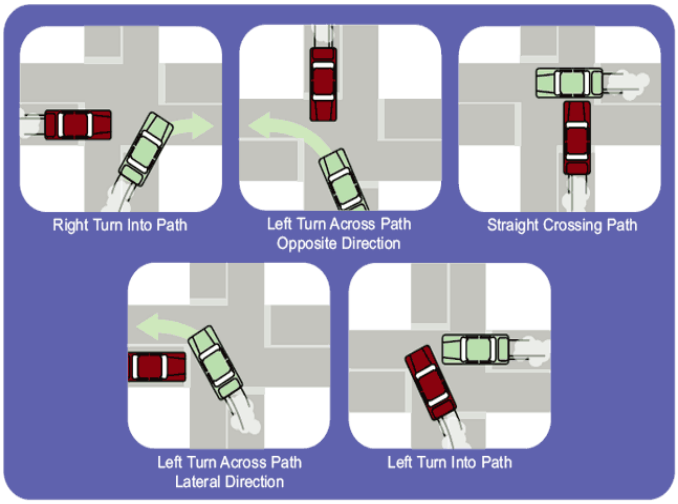


Fig : shows at junctions

Driving Reliability at Intersections

This section consists of studies related to driver reliability and errors. Driving errors has been identified as a prominent causal factor in road traffic crashes. Research suggests that up to 90% of all road crashes involve some form of driving error (Treat et al., 1979). Thus, a deeper understanding of driving errors

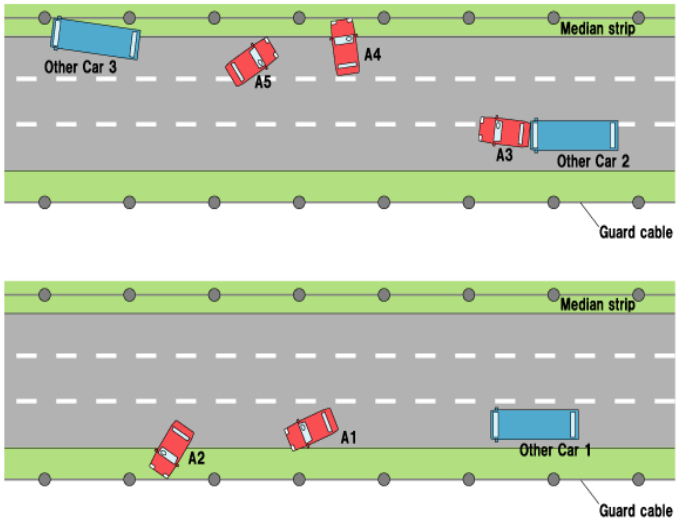


Fig : show the road accidents impacts

In one of those studies, Gstalter and Fastenmeier (2010) performed a study in order to estimate driver reliability and to compare driver groups of different age aptitudes on different pre defined driving tasks. This approach was tested in a field study with 62 drivers of different age groups. The subjects drove an instrumented car and completed an urban test route, the main features of which were 18 intersections representing six different driving tasks.

III. METHODOLOGY

The methodology as follows flow chart are involves for research the road accident parameters

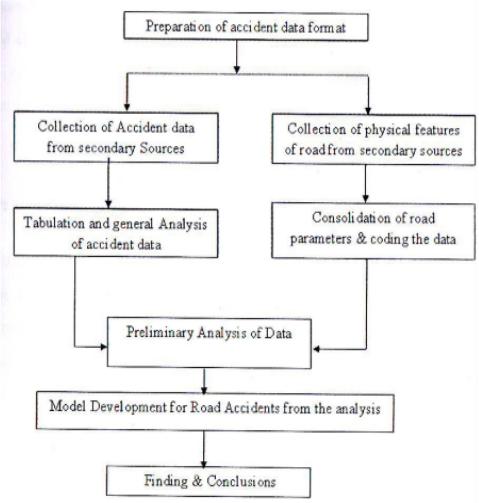


Fig.1 flow chart for methodology

Detailed analysis will be carried out through monthly, annual and hourly data and analyzed. Data collection: There are 6 selected intersections in selected segments. Intersection details are as given in table1. The data for above area sand intersections are collected from police records in accidents / year, traffic volume(major and minor road),turning affic volume in vehicles/day, pedestrian volume etc..Data is to be extracted from Accident data of whole record and also some data from HMDA and R&B department.

Data Collection

The first step of the methodology was the data collection. In order to carry out this specific research a comprehensive data set had to be collected. Different Information should be acquired so as to be able to consider and analyze different aspects of this research. The data that was collected can be separate din to two major categories. The first category refers to accident–based data, while these cond is related to vehicle – based data. Both the crash and the vehicle files were obtained inan MSEx celformat from the R&B Safety Office or from the Crash Analysis Reporting (CAR) System for the time period 2010-2014.

Selection of Variables

In the previous sub chapter, the available variables for further analysis were presented. In this study, firstly thirteen variables were selected out of the available variables for further analysis using log linear modeling. However, only ten variables were in corporate din the log linear models developed.

Data Processing

After the data collection, the data processing is applied. In this procedure, firstly the variable age needs to be merged from the vehicle – based file to the crash – based file. This is be cause the independent variable was chosen to be the number of crashes. Thus, the base file is the crash–based file.

Insertion of Data into SPSS

For the application of log linear modeling and the statistical analysis on selected crash contributory factors, the IBMSPSS Statistics22 platform was used. SPSS is widely used for in-depth data access and preparation, decision management, analytical reporting, graphics, modeling, simulation and forecasting. SPSS is frequently used in traffic safety studies for statistical analysis providing different model types to analyze from.

Variables Correlations

This methodology step is referred to the correlation between the variables. This procedure will ensure that all independent variables that will be included in the final models, are independent between each other. The goal is to isolate the effect of each one of the independent variables in the model. Thus, under the tab Analyze the option Bivariate Correlations was selected. Bivariate analysis determined the relationship between the independent variables by measuring how random variables change together.

The bivariate correlations procedure computes the Pearson's correlation coefficients in case of scale variables and the Spearman's correlation coefficients in case of nominal variables with their significance levels.

Test Fitting Process

The test fitting process is the most important step in our methodology. The purpose of this procedure (as it explained in section3.3), is to find the best fitting parsimonious model which will not be significantly different from the saturated model and will be significantly different

from the empty model in assign if i cancelevel ≤0.05. However, the inclusion of many variable sinlog linear modeling makes the interpretation very difficult. Thus, in this study, with eleven variables (before correlation test) up to 10-way interactions would be created, making the interpretation very problematic. In addition, the computation time would be very long especially without a very powerful computer. Thus, it was determined to examine only main effects and 2-way interactions independently.

Parameters Estimates

Once the best fitting parsimonious model has been found and being run, the parameter estimates are being calculated. From equation(1), λ's are the parameter estimates, which are generated from the software. The parameters timates are also called effect coefficients as the y represent the effect (either main effect or x-way interaction) of each variable in the dependent variable (total number of crashes). Once the parameter estimates have been extracted, only the estimates which are statistically significant for significancelevel≤0.05, should remain. This can be checked through the Z statistical test.

IV. ANALYSIS AND RESULT

Using curve fitting technique & SPSS software package, curve fitting is done to test relation between road intersection parameters and accident rate by Microsoft excel. SPSS software takes data from excel file and generates tabulated reports, charts and distribution trends.(Figs.2-10). For each model, regression coefficients, variances were found. Based on statistical analysis of secondary data of road accidents, relation between accidents and intersection parameters was found. like Accidents /year vs major road volume, minor road volume, turning traffic volume, pedestrian volume,approach width,turning radius, speed and no of legs.

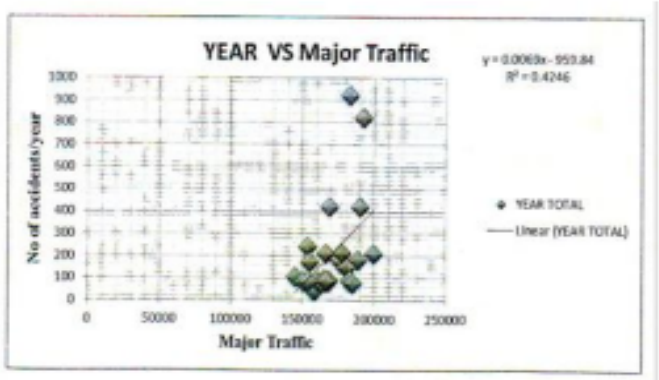


Fig 2 Major Traffic

A model was developed between accident rate and inter section parameters using SPSS regression analysis. Scatter plots were drawn between accidents / year as a function of parameters major road volume, minor Volume, turning traffic volume, pedestrian volume, approach width, no. of legs, unpaved shoulder width and turning radius.

Table 2: regression coefficients

VARIABLES COFFICENTS	MODEL 1	MODEL 2	MODEL 3	MODEL 4
CONSTANT	67.5711	324.0681	-65.1354	187.2354
MAJOR TRAFFIC	…….	0.0000	-0.0001	0.0005
MINOR TRAFFIC	0.0077	……	0.0081	-0.0039
TURNING TRAFFIC	-0.0025	-0.0059	…….	-0.0069
PEDESTRIAN VOLUME	-0.0340	-0.0207	0.0346	……
APPROACH WIDTH	-1.6887	-0.8866	-2.2525	-0.2387
NO OF LEGS	84.8679	-7.8870	105.8817	-21.6706
UNPAVED SHOULDER	-80.4882	-57.8540	-47.0821	23.7664
TURNING RADIUS	2.8751	2.9388	2.7246	1.0413
SPEED	-1.5654	-0.2140	-1.6650	0.6787
Correlation, r	0.897	0.844	0.894	0.668
Co-efficientof determination,r^2	0.805	0.712	0.8	0.447

A model form was developed. Among these models from table2, model 4 all parameters shows maximum relation with accident rate and hence adopted.

Model form Accident rate, Y = 5.0E - 04MRV - 3.86E-03mrv–6.91E-01AW– 2.17E + 01NL + 2.38E + 01UP + 1.04E + 0.00TR + 6.79E - 01V + 187.235

V. CONCLUSIONS AND FUTURE SCOPE

Relation between accidents / year and various intersection parameters were found and a model was developed from regression analysis. As number of intersections increase, accident rate increases, major traffic, unpaved shoulder, speed and turning radius have positive relation with accident rate. Minor traffic shows negative relation with accident rate.

Final Conclusions

According to synthesis of the extracted results, the final conclusions are summarized as follows:

a) From the statistically significant parameters' interactions:

- Crashes at junctions have lower crash probability compared to non – junctions for all heavy vehicle percentages in relation to base scenario (0-4%).
- Crashes at junctions have higher crash probability compared to non-junctions for speed limit 25-40mph when the bases cenario is the speed limit of 45-55Mph.

The opposite behavior is observed when the speed limit is 60-70 mph.

- Crashes that occur at junctions compared to non-junctions, are more probable in dark conditions with street light. The opposite behavior is observed in dark conditions without street light.

c) From the sensitivity analysis:

- Crashes are increased along with age until a peak is reached, which belongs in the age group of 26-45years. After that peak, when age in increased, crashes are decreasing.
- In almost all variables' categories, crashes proved to be higher at junctions compared to no-junctions.
- When AADT is increased, crashes are increased as well. In addition, while at junctions compared to no-junctions more crashes occur at low and medium volumes, the opposite happens at high volumes.

Research Limitations

The research limitations firstly can be identified in the insertion of the variables to run log linear models. Up to 10 variable scan be analyzed with the SPSS statistical software. In addition, the inclusion of too many variables makes the interpretation very difficult. Thus, it was decided in this study only the main effects and two-way interactions to be examined independently.

Future Research Recommendations

Future research can be developed in different directions. First of all, similar studies could be applied in smaller scale (microscopic models) in order to be applicable in local scale. Secondly, different parameters could be examined. For example, vehicle-based factors and roadway-based factors could be used. In addition, real data such as vehicle speeds or vehicle miles travelled could be used and possibly lead to better result interpretation. Moreover, using log linear modeling, more than two-way interactions could be used with probably less parameters.

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