ANALYSIS OF ACCIDENTS IN SECTIONS OF SPANISH ROAD WORKS AND THE IMPORTANCE OF MAKING THE SIGNS ON THEM CREDIBLE

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SUMMARY

Among the activities carried out by the Working Group in Security Works, that belongs to The Road Safety Technical Committee of the Technical Association of the Road (ATC), has carried out an analysis of traffic accidents with casualties that have occurred in work zone of the entire Spanish road network in the period 2000 to 2007.

The analysis is based on available data regarding the number of injury accidents also in terms of number of deaths. This document itself focuses especially on the most relevant results on the characterization of the accidents at work: the day of the week and the type of accident.

The second section examines the importance of the marking of road works, suggesting that this is one of the key elements for safety. In this regard, so important is that the signalling is correct, as it is meaningful to users.

Finally some conclusions, among which highlights the severity of traffic accidents on sections of work is significantly higher than that of the accident the rest of the network. On the other hand, it appears that the accident rate remains relatively stable throughout the week, including Saturdays and Sundays, which does not happen on average in the whole network, which produces trimmings weekends. Finally, we have found that the most common type of accident also differs from the average results, as in sections of works is the scope, while average for the whole network is out of way

1 .- ANALYSIS OF ACCIDENTS IN ACCIDENT VICTIMS IN WORK AREA IN THE PERIOD 2000 TO 2007.

Among the activities carried out by the security working group works, the Technical Committee on Road Safety of the ATC, it has proceeded to an analysis of injury accidents that have occurred in building area, existing database of the Directorate General of Traffic, from 2000 to 2007.

Data considered in each of the accidents and have served as a basis for analysis, were:

- Road
- Kilometer
- Accident Type

- Dead
- Graves wounded
- Minor injuries
- Day / Night
- Day of the Week
- Time
- Hazard Signage
- Visibility vertical signage

Once grouped by year, type of accident, Administration owns the road network, day of the week... Set out various lines of work that we develop briefly.

First place it is purpose of this analysis to evaluate the quantification of the accidents with casualties occurred in areas of works on the total of an accident involving the red, differing from these accidents that have taken place in the National Road Network of the Central Administration and the other networks, both in terms of a number of accidents as a number of people killed in them.

Following is an analysis of the weekly distribution of injury accidents in work zones in the total road network and the weekly distribution of deaths in such accidents in the total road network.

Then we analyze the types of accidents with victims in work zones in the total road network both in number of accidents as the death toll on them. To finally compare the types of accidents with the most common victims dead in them were produced and compared, also, accidents with most fatalities occurring in work zones with the type of accident that has caused.

For a first estimation of the incidence and significance of the injury accidents in work zones in the road network can be obtained which is the percentage that the number of injury accidents in the work area, to the total number of accidents victims in the road network.

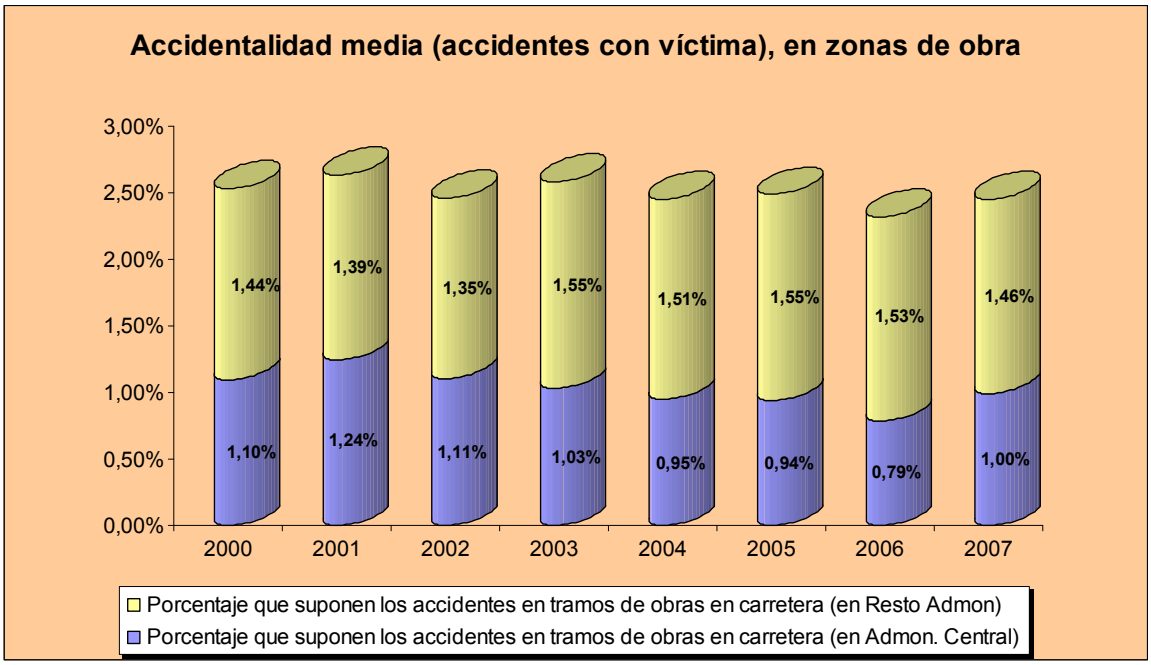

Figure 1 - Accident average (injury accidents) in work zones

Thus, we find that the number of injury accidents on sections of works in the period 2000 to 2007, representing 2.49% of total injury accidents occurred on the road network in Spain. 1.02% of them have occurred in the road network of the central government and 1.47% remaining in work zones in the road network from the rest of government.

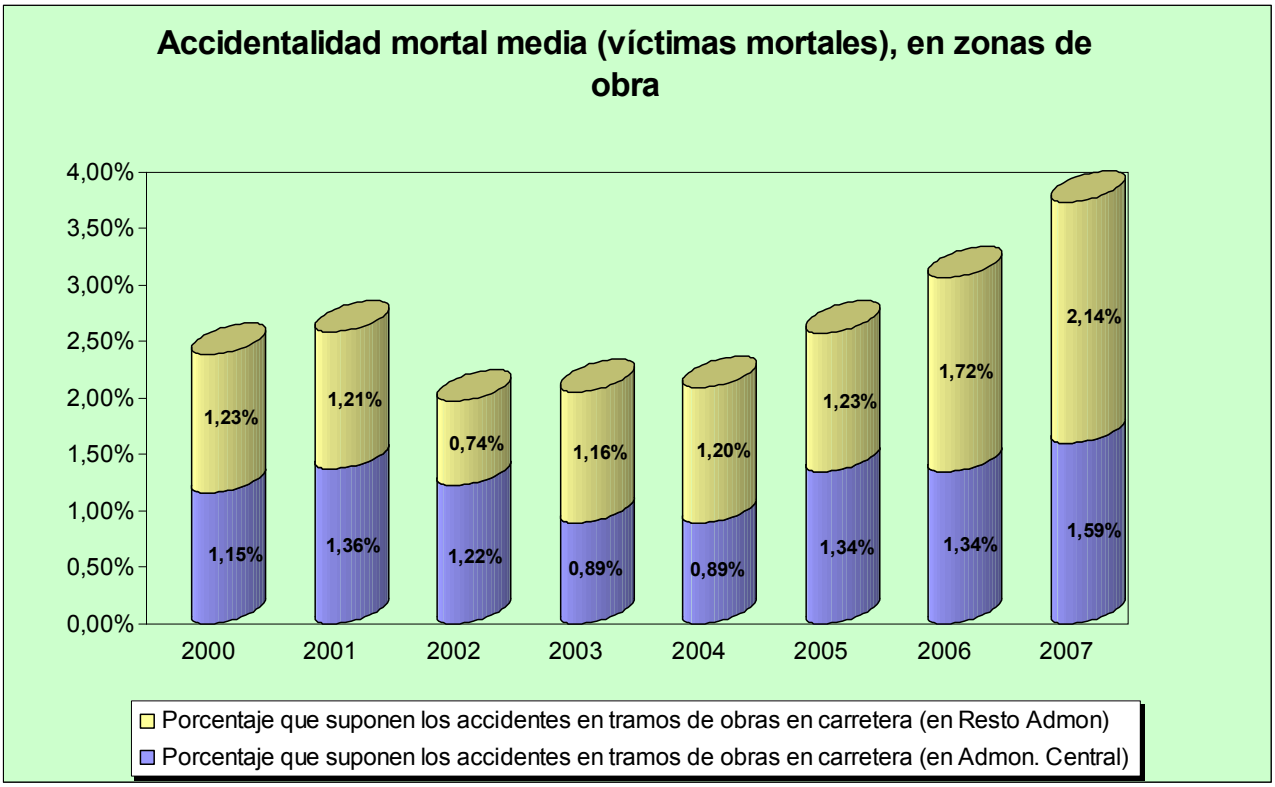

Figure 2 - Accident mortal average (fatalities) in areas of work

If we perform this analysis according to the number of fatalities, it appears that 2.55% of road fatalities occur in accidents in work zones (1.22% in the network of central government and 1.33 % Was spent on roads in the rest of the government).

In other words, we are dealing with rates of injury accidents in work zones that have a significant amount, considered absolutely and in percentages of the total injury accidents occurred in different road networks.

Similarly the number of fatalities in accidents in the work area has higher percentages than those obtained with the total number of injury accidents in the work area, which indicates that its gravity is slightly higher than that of other injury accidents.

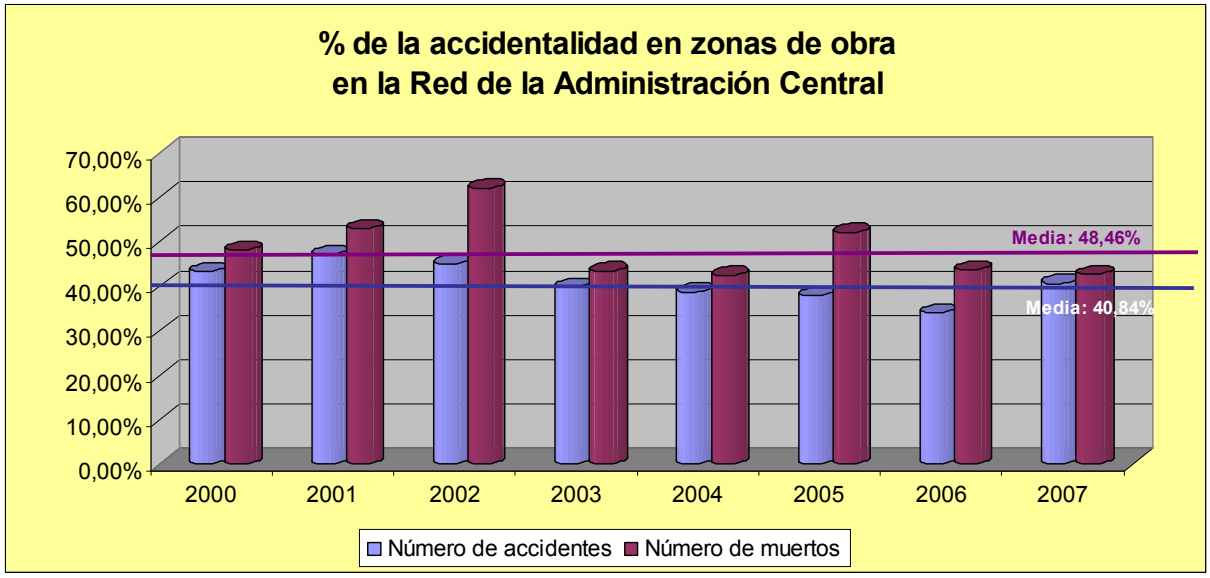

Figure 3 - Percentage of accident in work zones on Central Administration's roads

If we focus on the road network of the Central Administration, it takes place on 40.84% of the total number of injury accidents occurred in work zones and that also means the 48.46% of total victims fatal accidents in work zones in Spain.

We analyzed the evolution of mortality rate (number of fatalities per 100 accidents), the whole network in the same period (2000 and 2007) and the hazard index (number of injury accidents per 100 accidents) on the sections of work.

From this analysis that the evolution of the index of severity (fatalities per 100 accidents) in the entire network in that period is clearly decreasing, from 10.5 deaths per 100 accidents in the year 2000 to 6.2 in 2007. On the contrary if we look at this same time period the severity index only of the road works we note that starting from a lower value in 2000, 9.9 deaths per 100 crashes, there is a downward trend until 2004, from which trends change and there is a spike to reach the 9.4 deaths per 100 accidents in 2007.

Once quantified the importance of the injury accidents in work zones, with a percentage of them almost constant for the total number of accidents with injuries occurred in all road networks, we analyze the weekly distribution of themselves.

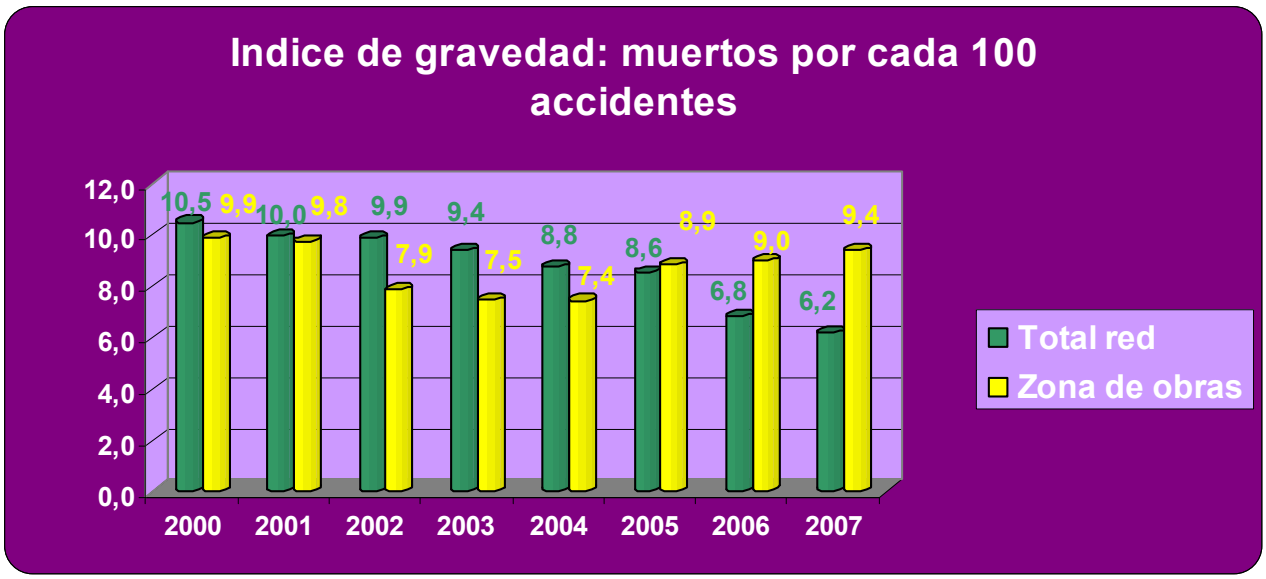

Figure 4 - Comparison of changes in Severity Index in the whole network and work zones

Thus, considering the day of the week when the accident occurred, is a high degree of homogeneity in the weekly distribution, with a daily average of injury accidents in the work area of 14.28% (being the maximum value of 15.03%, Wednesdays, and 13.17% at least on Sundays).

Also note that on weekends the number of injury accidents in the work area have a mean value slightly lower than the other days of the week (14.09% on weekends, compared to 14.36% of weekdays).

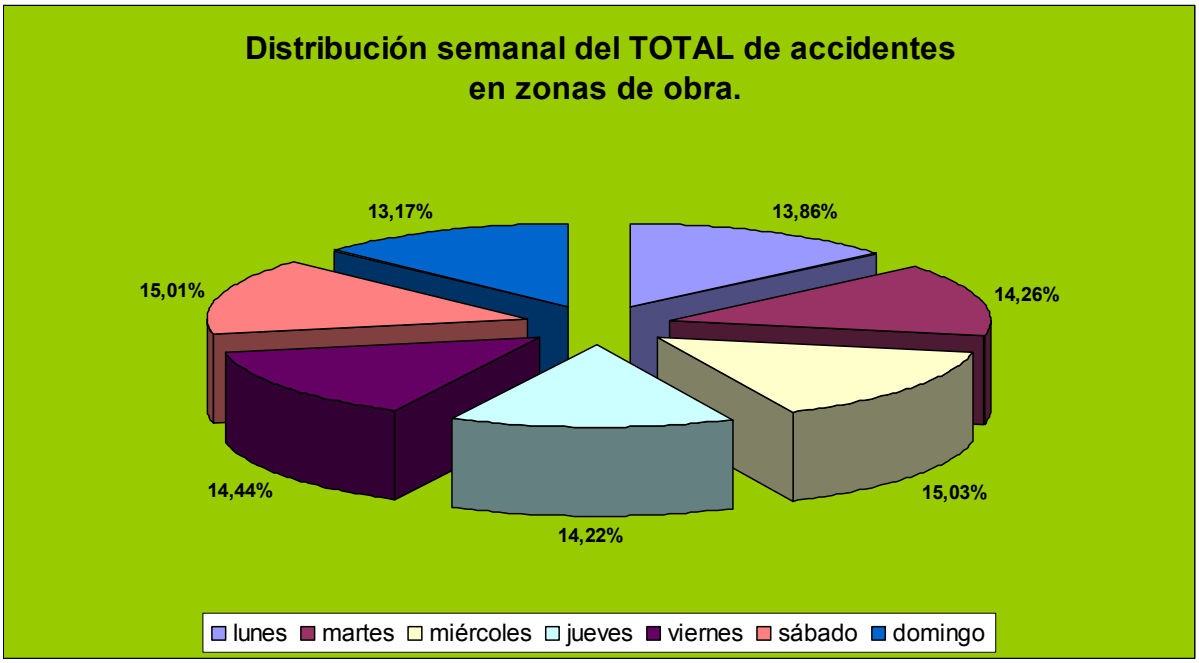

Figure 5 - Weekly distribution of injury accidents in work zones

Similarly with regard to the daily distribution of weekly number of deaths due to accidents in work zones, noting that maintaining the homogeneity found in the distribution of the number of accidents, but slightly larger. Thus, the average daily fatalities in work zone is

14.29% of total produced (with a maximum of 16.50% on Monday, and a minimum of 11.38% on Friday). On weekends, although there were fewer accidents than other days of the week, the death toll is higher than the average for other days of the week (14.63%), indicating that gravity of accidents is higher on weekends, or the occupation of the vehicles involved in accidents is higher in those days.

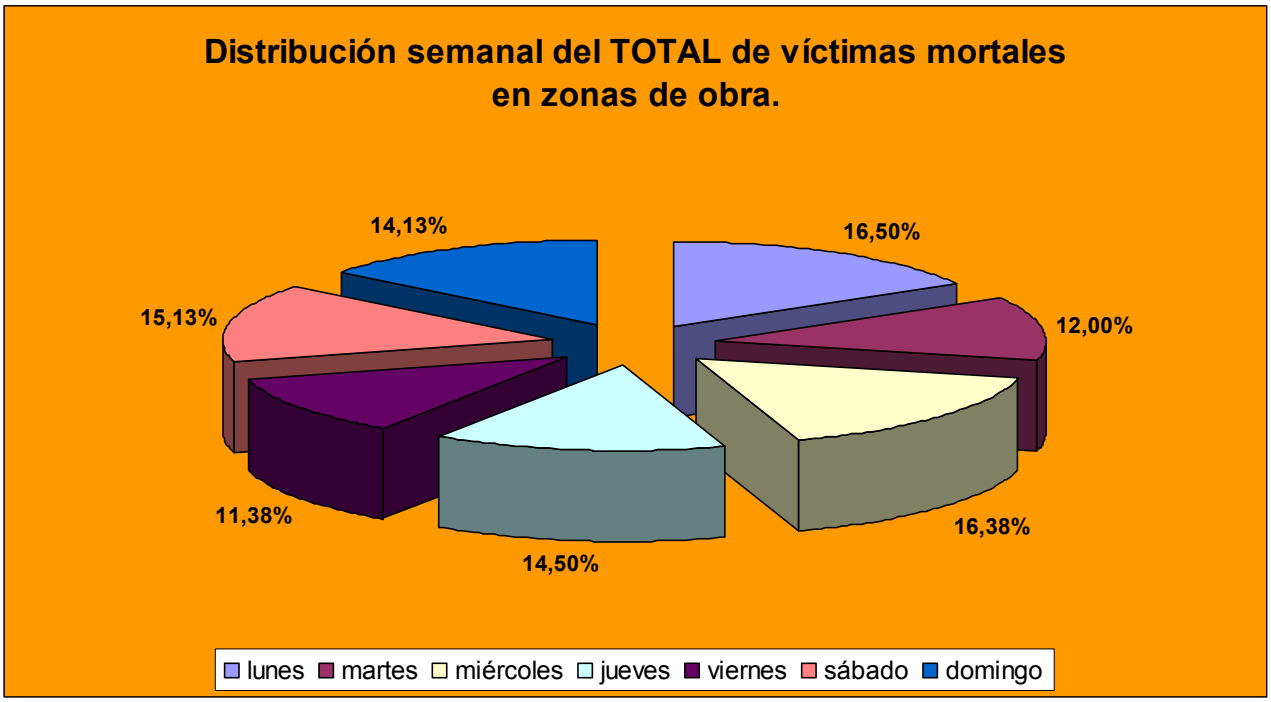

Figure 6 - weekly Daily distribution of fatalities in work zones

This indicates that in areas of work does not remain the same parameters obtained for all the injury accidents on the roads of Spain, where it is during the weekend when there are more accidents, the latter being well as more serious. By contrast, in work zone accidents are fewer during the weekend but more severe than occurred in the remaining days of the week.

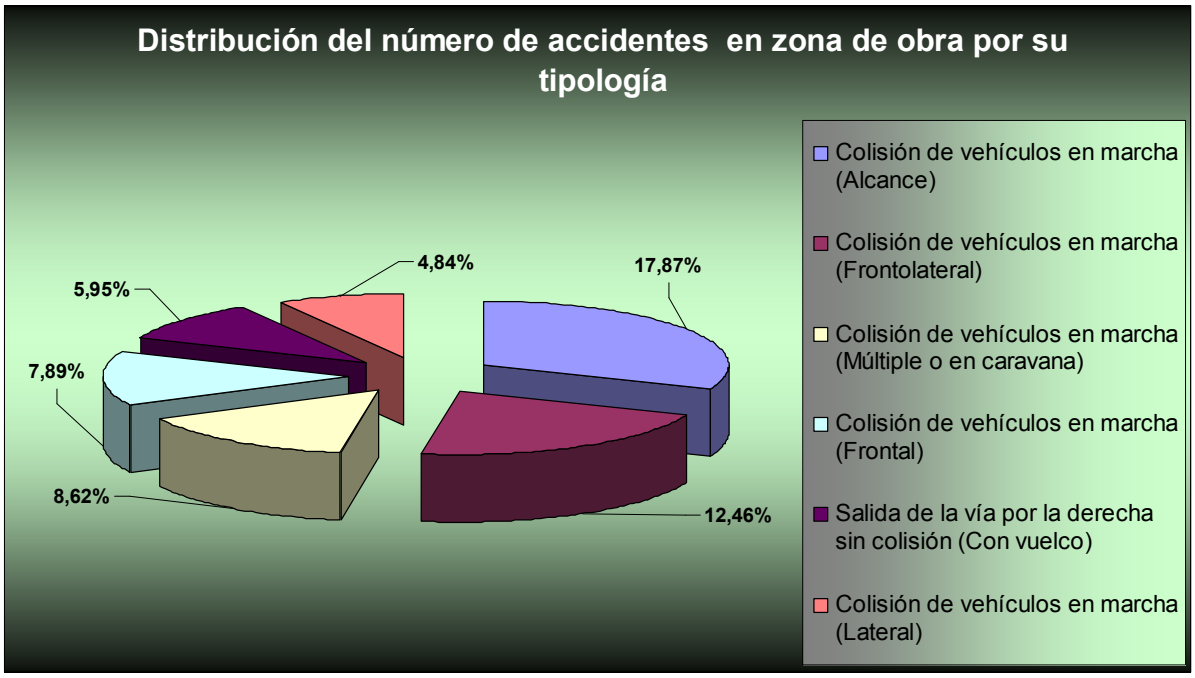

Figure 7 - Distribution of the number of accidents in work zones for their type.

Analysis of the types of accidents with casualties in an area of work, one can conclude that the scope of vehicles is, with 17.87% of the total, the most common injury, followed with 12.46%, the *frontolateral* accidents from moving vehicles. That is, these two types of accidents account for approximately one third (30.33%) of all injury accidents in work area. But not these kinds of accidents are the highest percentage of deaths occur. This is true both on the roads of Central Administration and in those belonging to other local administrations in Spain.

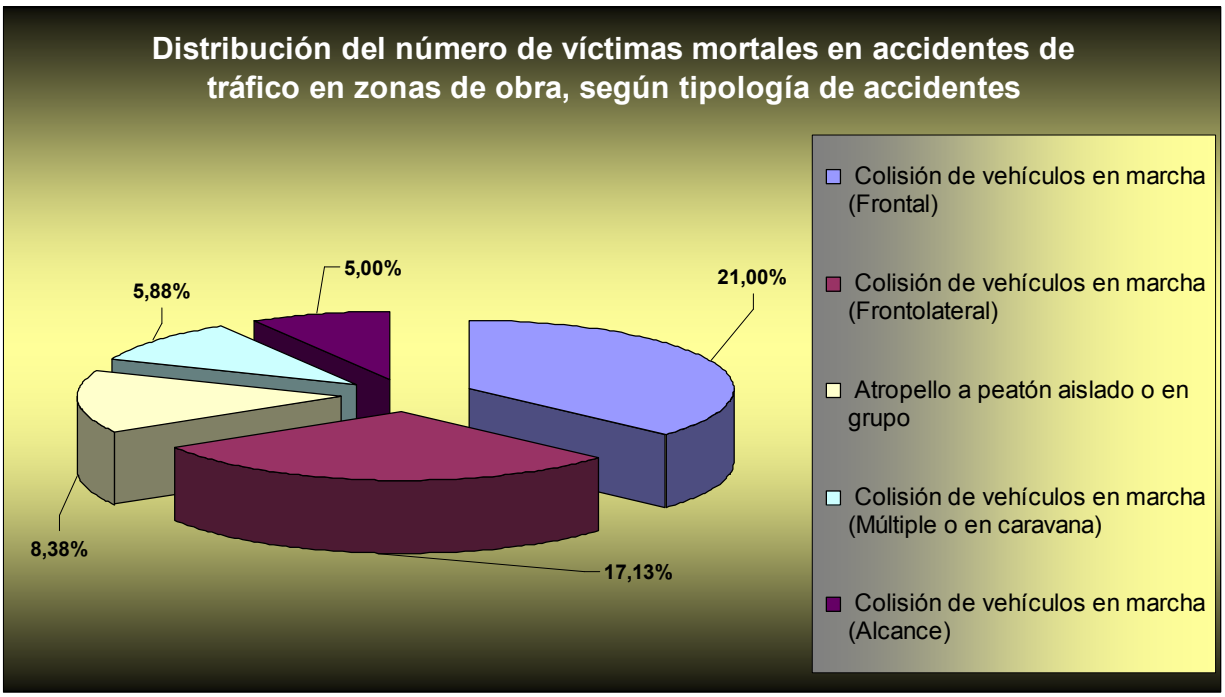

Figure 8 - Distribution of fatalities in traffic accidents in work zones, depending on the type of accident

Thus, the most common injury accidents in the work area are the strengths and *frontolateral* collisions, as already discussed, followed at a considerable distance, multiple collisions, frontal crashes, the outputs of the line with tipping and side impact. They represent something more than two thirds (67.52%) of all accidents in construction sites and half (55%) of the dead in them.

Given the types of accidents with victims in the work area, which generate most deaths are on collisions (a 21.00%), as expected by the gravity of this type of accident. Collisions followed *frontolateral* (17.13%) of all deaths in this type of work zone accidents. A great distance from these are the abuses of pedestrians, which is significant (8%) because the work area to address in largely correspond to operators that are working. And with the lowest percentage are multi-collision or collision caravan and scope. They represent just over half of all deaths (57.38%) and accidents (50.14%) in work zone.

If we look at the distribution of types of accidents as the incumbent administration of roads, are not overly significant differences between the network of Central Administration and other road networks of other road administrations in Spain.

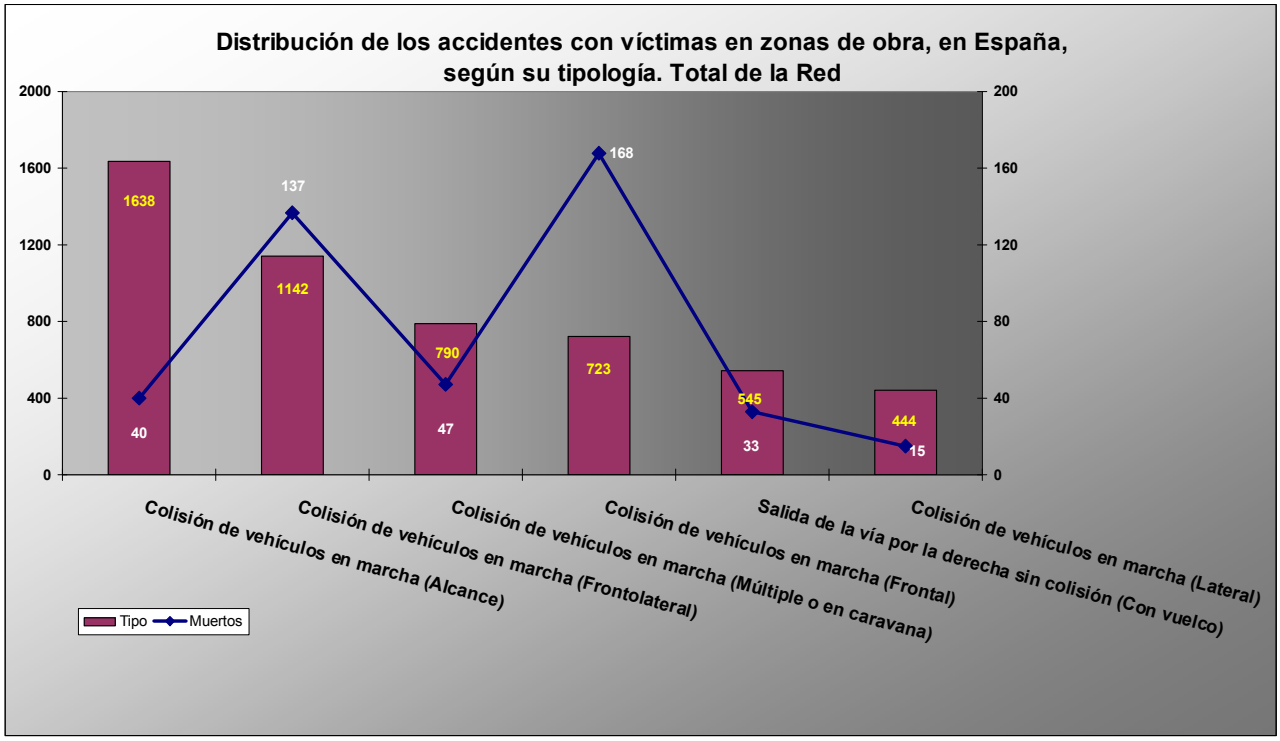

Figure 9-Distribution of injury accidents in the work area in Spain by type.

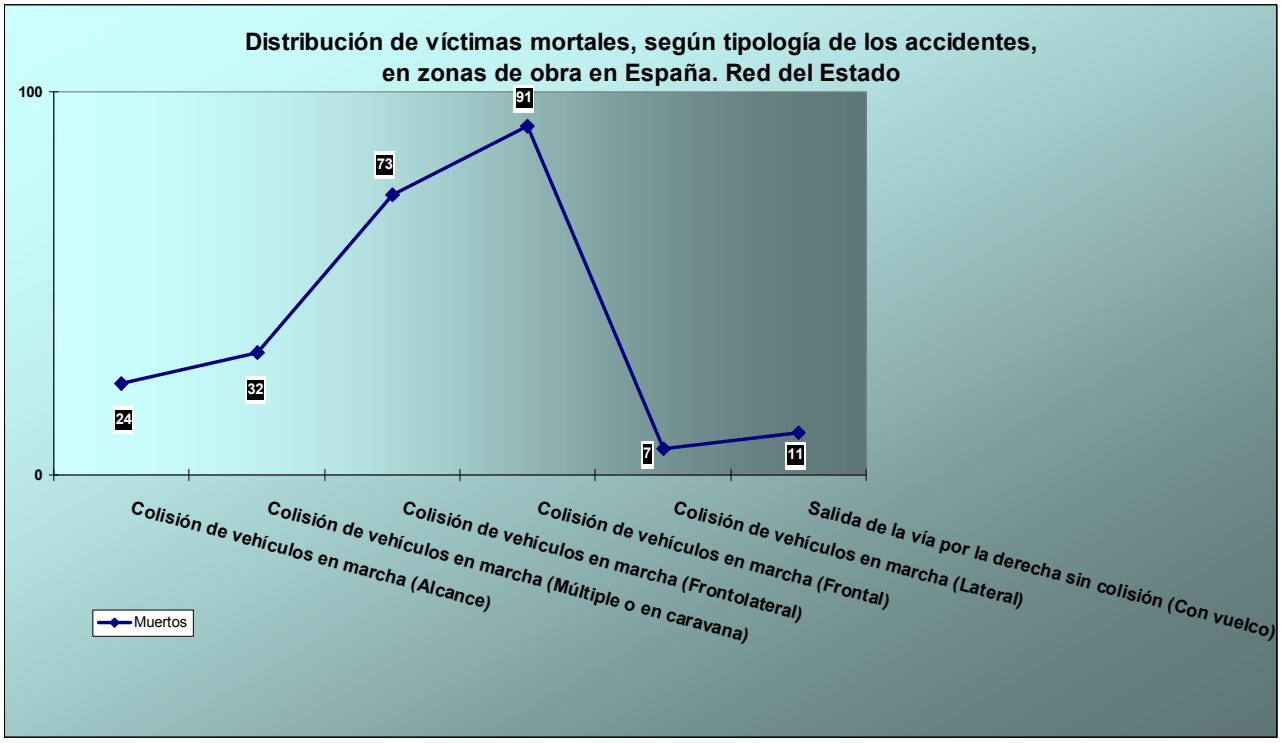

Figure 10 - Distribution of deaths by type of work zone accidents in Spain.

As noted in the distribution of fatalities and accidents in work zones according to their type, severity of such accidents did not match the most common accidents.

If we look at the hourly distribution of accidents with injuries in work zones, is that 31% of these accidents in Spain are between 8pm and 8am the following day, similar to the corresponding percentage of total accidents (not just sections of works). In contrast, the percentage of fatalities in road accidents in road works during night hours is 40%.

Figure 11 - Distribution of time interval of accidents in work zones

As the night time (between 8pm and 8am) the period of the day with lower traffic density is, however, the most dangerous.

If we perform this same analysis for the whole network, but considering only those killed in accidents at road works, we obtain, for the period 2000-2007, a percentage of fatalities of 40% or 2% we get increase in mortality in a work zone at night with respect to the total network.

Thus, the rate of gravity of traffic accidents on the stretches of night work is 50% higher than daytime accidents, to be a value of 11.4 deaths per 100 accidents during the night and 7.6 during day.

2 .- THE IMPORTANCE OF THE SIGNAL TO CREDIBLE.

Once quantified and qualified the problem of accidents in work zones, we must emphasize the distinguishing aspect of the work of other sections of the network.

In many cases, the only element that differentiates one driver who is running through a section under construction is the existence of temporary signs from them. Signaling works are also the elements of collective protection of the workers who run the work.

Hence its importance, both safety-related driver (to influence the perception of the driver, its role in the traffic channel to alter its path and forcing the reduction of approach speed and passing through the area works) and the related security for employees who have to execute the work.

Thus, depending on the type of road where works are implemented, the degree of occupation of the same and its duration, the statement works signaling establishes a series of requirements, in any case minimal, it must meet all temporary signage works.

States that proper marking of a section of works should begin with the placement of a first signal works, size and level of reflectance depending on the category of the road, being always the same double, i.e. on both sides of the road .

Later proceed to limit the speed of approach to the construction site, performing the same with a scale not exceeding 20 km/h. Thus, if the road is a generous limit of 100 km/h, the first speed limit is 80 km/h, was placed on restriction to 60 km/h, not limiting below this speed unless the suspension is expected Total vehicles by the existence of alternative step regulated by traffic lights or by an operator and its corresponding stop sign.

We must continue with the ban on overtaking, which will also be double (i.e. should be made on both sides of the road) and a following speed limits, warning traffic light, stretching, step speed again ...

Once the traffic has become a rate consistent with the constraints, without having changed its path and overtaking is prohibited, you should proceed, provided before the construction area, the modification of the vehicle's path using directional panels traffic and channelled away from the area of works.

The work area must be suitably signposted avoiding excessive traffic approximation to it.

And once the site plan should indicate the vehicles completion of the limitations and requirements generated by them by placing a sign at the end of prohibition, so that traffic is still governed by the limitations of Highway concerned.

To all this must come together this set of tentative signs of work should be placed at sufficient distance from each other, never less than 50 meters, so that drivers have time to catch them and adapt to traffic conditions set by them.

Scheme seems not too complicated, except perhaps by the fact that they pay special attention to the times of insertion and removal of temporary signs in work and to see that the set of road signs not contrary to laid down the temporary signs, in which case the markings shall cover fixed.

However, experience tells us that there are frequent cases where the signaling of works does not meet the criteria and requirements specified in the manual signaling, both in number and placement as on their level of reflectance, which is not and adequate nighttime visibility and bad weather either. And therefore do not credible provisional signaling the driver works.

Figure 12 - Real World Example signaling works

A picture is worth a thousand words. Thus, Figure 12 shows a signal of works is an example of incorrect signage works: it has the yellow background to signal regulatory action, is impaired and the level of reflectance is clearly inadequate, it is a isolated signal and also prepared a wrong height (it is supported on the ground when the height above the floor must be at least one meter. It is therefore the driver with a high degree of probability, it will ignore.

Figure 13 - Signal totally dirty

At other times the signs may be correct or not, because it can be impossible to know what is indicated. For example in Figure 13 there is something that seems to be a signal that has lost its functionality and has been guiding and condition the flow to be an obstacle in the road that may create a risk for vehicles.

Much is at stake with the proper placement of temporary signage works. We played the driver perceives the existence of an unusual risk in a situation that changes the normal traffic for a particular road. We play once perceived the new situation to react to the existence of a specific sign telling you, truthfully, those actions that provide security. And we play, finally, that workers have to perform the works focus attention on the risks inherent in the work units that are running and do not increase the risk of them by distractions that are caused by traffic passing along the works.

All this happens by raising awareness in the design, installation, maintenance and subsequent removal of temporary signs of works as the transmission of all these signs should have a clear origin and use appropriate and proportionate to the activity being carried out in the road environment.

3 .- STUDY FINDINGS

During the period between 2000 and 2007 in Spain, the percentage of victims of traffic accidents on sections of works accounted for 2.49% of total accidents involving casualties occurred on roads in Spain. The number of fatalities in traffic accidents in work zones representing 2.55% of total casualties in traffic accidents on Spanish roads.

I.e. traffic accidents in work zones have a meaningful representation, taking into account that not as many legs and, in general, the duration of these works is not large (basically try specific actions).

Moreover, the danger of such accidents in work zones is significantly higher than accidents in other parts of the network of roads.

The evolution of the severity index (defined as the number of fatalities per 100 accidents) of traffic accidents in work zones during this period is not very favorable, as virtually remained (going from a rate of 9, 9 in 2000 to 9.4 in 2007). Instead of gravity on the set of accidents (not just in work zone) has been reduced by 41% over the same period, from 10.5 deaths per 100 accidents in 2000 to 6.2 in the year 2007. That is, while in 2000, the severity of accidents in road works was similar to that of the total network in 2007 is higher (a trend that began from the year 2005).

Based on the daily weekly accidents in work zones, there is a high degree of homogeneity if it is on weekends when there is slightly fewer accidents but instead are more severe than occurred in the rest days of the week. However, in the sections that are not works more accidents occur on weekends and are also more serious.

The types of accidents in work zones are more common scope (18%) and collisions *frontolateral* (12.5%), accounting for almost one third of all accidents in work zones. In contrast, the greatest number of fatalities occur are frontal collisions (21%) and *frontolateral* (17%), being significant the place of outrage (third, with 8%), generally operators.

Finally note the importance of adequate signage works as an effective tool both to improve the safety of drivers (for affect the perception of the driver, its role in directing traffic to alter its trajectory and drive down approach speed and passing through the construction area) and the collective protection of the workers who run the site. Therefore, we must work together to achieve greater awareness in the design, installation, maintenance and subsequent removal of temporary signs of the works, so that the transmission to the user of the information contained in that signal must have a clear origin and be appropriate and proportionate to the activity being carried out in the road environment.

As a final conclusion can be said that traffic accidents in work zones in Spain continues to have a meaningful representation (2.5% of total), there is still potential for improvement in the safety of these sections, and in more efficient actions in this regard is the improvement of the signal of the same, that this is adequate and more credible for users.