

Ten Years with Passive Safety – a Manufacturer’s View

by Kim H. Heglund CEO Lattix Ltd.

Kim H. Heglund has been involved with the designing, developing, testing and producing passively safe traffic masts since early 1990. He is based in Norway outside Oslo. Since the Scandinavian countries were forerunners in passive safety, Kim H. Heglund had the advantage of early involvement in the development of Scandinavian and more recently European standards. He was a member of the so called “Nordic Working group” in the late 1990’s, the first working group to start looking at how to implement the (European) EN 12767 approved masts into the road network. He has later participated in several national and international working groups connected to passive safety. He gave the (British) Highways Agency advice when TA89/04 was originally drawn up and more recently provided advice for the forthcoming British guidelines in their National Annex to BS EN 12767. The following article will be published in the United Kingdom on 21 May 2008 in the book ‘Safer Roadsides – A Handbook for Engineers’ edited by David Milne and published by The Highway magazine TEC. The ACRS thanks Kim Heglund for making his article available to the Journal.

Initial thoughts and reflections

Over the last 10 years I have worked to develop and promote the use of passively safe traffic masts (used as signposts and to support roadside equipment). Over this period the understanding of passive safety, the national application guidelines and the products themselves have all greatly evolved. In the early days before EN 12767 “Passive Safety of Support Structures for Road Equipment – Requirements and Test Methods” first published in 2000, there was a growing appreciation in Scandinavia that positioning hard and heavy objects alongside roads created an intolerable risk.

In those days one did not seek to redesign such objects by making them lighter in weight and/or softer, but rather to either shield them from impact with a crash barrier or to use a “slip base” system so the post or mast sheared at its base on impact. There are still heavy steel masts with slip bases on highways in Scandinavia, next to modern lightweight and softer traffic masts. In my opinion the use of heavy steel masts for signposts or lighting columns with a slip based system is a sort of Russian roulette. Either it functions and shears or if you are unlucky, it locks and fails to shear. When a heavy steel mast shears off in an impact it bounces off the vehicle at speed with a real risk of a secondary accident. If it fails to shear the consequences are usually serious.

In England there was little or no historical use of slip based products and the Highways Agency there wisely adopted the light weight BS EN 12767 approved masts for signposts from the start on trunk roads



In Norway we have extensively used Lattix lightweight yielding NE masts to EN 12767 for signposts and similar applications and these are permitted at all locations. Norway also still has slip based products, which are typically heavier steel posts that break away or slip off the base on impact. The posts do not readily deform or absorb energy on impact and so tend to bounce off the vehicle in an impact (always provided the base slips). They are not allowed to be used on slopes because if they are hit at a high level they lock up and fail to yield and soften the impact. These products can be a danger in urban areas due to the risk of secondary accidents.

I will explore how passively safe masts (typically signposts, lighting columns and traffic light posts) are being used differently in England and Norway and conclude with my views on what advice national guidelines should provide in this area.

The Ideal “Forgiving Roadside” a Dream or the Future?

Modern safe road design should where possible include wide open verges with gentle slopes so errant cars can lose speed without hitting anything. The RISER project report, (a European 5 year road safety study involving several countries) “*designing and keeping roadsides safe*” strongly agrees with this principle. Safety is best achieved through the design of forgiving roadsides and the use of *forgiving traffic signs/signals/street lightning*. The report draws on input from 8 countries and 5 years of statistics. It actually shows that barriers are a serious danger on motorways and roads and should only be used where it is impossible due to lack of space (or any other reason) to provide a *forgiving roadside*. Often cars hitting barriers are thrown back into the traffic.

It is proven that barriers do save lives and at many locations there are no alternatives. There are energy absorbing terminals and crash cushions now on the market that provide a far safer alternative to the older ramped end terminals to safety fences which caused so many severe accidents.



E18 Motorway showing widened centre reserve with no barrier, passively safe sign posts, passively safe lighting columns and gentle side slopes to retain traffic

However my view is that modern safe roads should be provided with wide verges with gentle slopes, wherever possible, to gradually redirect the errant vehicles gently back towards the carriageway. I am convinced, even where land is expensive, that providing wide central reserves and verges (with suitable attention to slopes and banks to guide errant vehicles) will be significantly safer, more cost effective and more aesthetically pleasing than providing and maintaining expensive barrier to a minimum width highway when the ongoing cost of accidents and injuries is properly accounted for. Barriers should of course be used where they are essential and there are no alternatives.

In Scandinavia, as the picture shows, on some new motorways like the E 18 and E 6 south of Oslo, even the normal central



E 18 in construction

The road minimises the use of barriers where possible, all signs are light in weight and sign support masts and lighting columns are passively safe (light in weight and yielding energy absorbing products and not slip based products)



Forgiving Roadside, not only the future, but already here in the UK

reserve crash barriers to stop cross-over accidents are not always installed. This is because the motorway itself was actually designed and built as two separate roads with a significant wide centre reserve and a gentle depression aimed to avoid cross-over accidents. Since opening of the new part of E 18 south of Oslo in 2002 only one fatal accident has been recorded. Before 2002 between 5 and 10 people died each year.

The use of lightweight passively safe structures without barrier is not only safer but also more economical and faster to install (and to replace after an accident). Speedy installation and replacement of signs and street furniture is becoming ever more important on congested motorways where traffic management is disruptive and expensive

The NE, LE and HE classifications and the choices to be made.

Differing road and traffic conditions will lead to a choice of different types of mast. BS EN 12767 is a protocol that describes how to carry out a very specific crash test and then how to measure and categorise the results. The results are used to divide masts into various categories. It does not advise on how the resulting classifications should be used when selecting or specifying masts and lighting columns for use on the highway.

The standard categories are Non Energy (NE), Low Energy (LE) and High Energy (HE). The category a mast falls within is derived from the exit speed of the vehicle after impact in the high speed test and is thus related to the loss of velocity of the vehicle (and thus its kinetic energy) in that test.

The kinetic energy that is lost in the test from the vehicle is largely absorbed by:

- a) the deformation of the car structure mainly at the front - if this goes too far this can obviously threaten the integrity of the passenger compartment and it is obviously desirable if the energy can be lost elsewhere
- b) absorbed by deformation or for fibreglass reinforced plastic structures degrading of the structure of the mast (the post or lighting column). This is the best place for the energy to be absorbed as it does not threaten the integrity of the vehicle.

c) transferred as kinetic energy to the mast or the equipment on the mast. If the post does not yield or deform or degrade in the impact it can bounce off like a billiard ball and thus take kinetic energy with it. This again is undesirable as there is a risk of the mast causing a secondary accident. This is a characteristic of rigid steel slip based posts on impact

What happens to the energy can be as important as how much velocity is lost in the test. In my view, solely relying on the energy classification can be misleading, especially for the NE class. The name “Non Energy” indicates a class where the mast does not absorb energy. Some energy will always be lost in an impact.

A “hard” heavy steel mast on a slip base can cause deformation to the front of the vehicle and fly off at some speed with transferred kinetic energy and yet still attain a NE classification. This is very wrong in my opinion.

For a “soft” deformable energy absorbing NE post the energy will be lost in the plastic deformation or degrading of the post material. The post will not acquire significant kinetic energy or bounce off the vehicle at speed but will be comparably inert in an impact and not move a significant distance from the point of impact. This is a safer failure mode especially in an urban situation with pedestrians.

Then there are true energy absorbing poles and masts which progressively deform in an impact. They are usually formed from thin walled aluminium tubes or tubes formed from rolling thin steel plates. Lighting columns are typical examples. The tubes deform or flatten on impact and thus absorb energy whether categorised as NE, LE or HE.



Obligatory EN 12767 low speed 4425 NE test (35 km/h = 21.0 miles/h).

The photographs above show our deformable energy absorbing NE product deforming on impact in a successful low speed EN 12767 test. The light strong structure is deforming and crushing before it breaks away from its base. Because of the deformation of the mast it is inert and does not bounce away from the impact and will fall to the ground very close to its original position. It can be seen the product absorbs energy even if it's classified non energy or NE.

In my opinion, lightweight energy absorbing masts are suitable for use in urban areas regardless of their classification. Thin walled aluminium tubes or even roll form steel tube masts also have energy absorbing qualities.

Conclusion: Some measure of the energy absorbing abilities of the mast itself should be part of the EN 12767 testing regime, especially in the NE class to reflect the need for a product to absorb energy in an impact and prevent “bounce”

3 fundamental questions have to be asked before producing/deciding a National Annex :

Question 1:

Should passively safe masts be used extensively in urban areas and where speed limits are less than 50 mph

Relatively low speed accidents with standard (i.e. not passively safe) signposts, lighting columns and utility poles are dangerous since a car will often stop more abruptly than in a higher speed accident because the post or mast is more likely to bend or shear or the ground fail allowing post rotation. A speed of 50 km/h (about 30 miles/h) is fast enough to cause serious injury. Passively safe masts which are truly “light”, “soft” and “deformable” and “energy absorbing” are safer at all speeds. Where speeds are limited to 20 mph (which also significantly increases the safety for pedestrians in accidents with vehicles) and the limits are abided by it is probably not necessary to use passively safe street furniture as the speeds are probably slow enough to avoid serious injury.

Question 2:

Should only HE and LE masts (and not NE Masts) be used in urban areas or areas with regular pedestrian or bicycle users?

My answer is no. Lightweight energy absorbing NE masts are suitable (In Norway there are no government approved LE signposts)

I will try to explain why I believe passively safe posts are necessary for speeds above 20 mph and why NE masts are suitable where there are pedestrians and cyclists:

1. Confusingly a modern yielding energy absorbing deformable lightweight mast can be categorised NE, LE or HE depending on length, the equipment or sign carried and the base fixing details. Therefore one can actually question if the categories HE, LE and NE are a good guide to safety and performance or even necessary?
2. In my opinion the most important traffic safety parameters for a post especially in an urban area are:
 - a) Low weight
 - b) The ability to readily yield and deform and thus absorb energy in any impact
3. Energy absorbing deformable lightweight masts and columns will always give the lowest risk. It is also easier to have lower decelerations (and thus lower Theoretical Head Impact Velocity (THIV) if the mast is allowed to break away at its base. NE posts are typically designed to break away and this lessens impact decelerations.
4. If the aim of using passively safe masts is not only to reduce risk in the collision itself but also to slow or stop the car to achieve a LE or HE classification the base of the post cannot be permitted to break away and the decelerations (and THIV) will need to be higher to achieve the required speed change. As a result LE and HE classes impacts will be **more severe** and as a result it has been necessary to accept higher THIV ASI values in EN 12767 for HE products. (ASI = Accident Severity Index).

5. We have found as a manufacturer after expensive crash tests and computer simulations that it is very difficult to develop LE and HE products for signposts, that it is extremely difficult if not impossible especially for medium sized signs with a single mast.

I will try and explain why achieving an LE classification for a sign with a single post is so difficult:

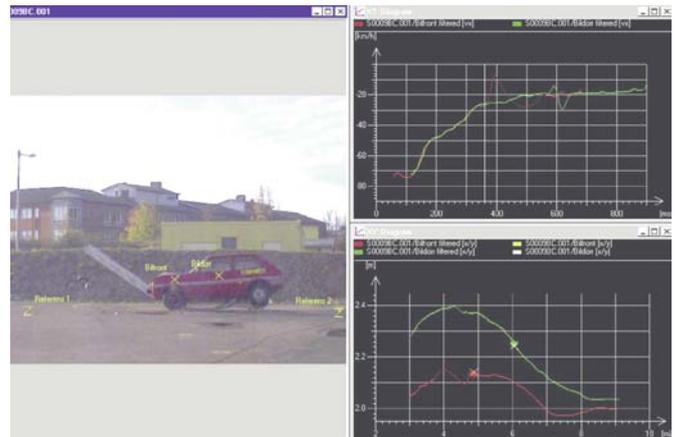
- The length of signpost between the underside of the sign and the ground is effectively the length available to distort and so absorb energy and thus slow or stop the vehicle. It is difficult for a sign mast to slow up a vehicle in such a short distance without causing such high decelerations that THIV and ASI limits are exceeded (lighting columns have a longer length to slow the vehicle allowing a gentler deceleration and so find it much easier to comply). So this actually rules out the HE class and leaves us with the LE class where the car speed is only to be reduced by approx 50%.
- The weight (and resultant inertia) of the sign itself on top of such a short mast makes the top of the mast (with the sign) readily bend over the front of the car when hit.
- The sign, if large, will not readily pass under the car even if the mast and the sign bend forward on impact
- The problem in achieving a LE or HE rating will be common to all lightweight energy absorbing passively safe signposts.

We currently believe the only way to achieve a LE approved signpost, is to use at least two posts to support a sign. When then a LE post is hit, it would need to disengage or instantly break away from the sign and so permit the post to pass underneath the car while being flattened and distorted and thus absorbing energy to reduce the car speed.

From the above tests we learnt that when designing for safety it is important to consider what object a signpost will carry. A heavy Variable Message Sign (VMS) will be a great danger to a vehicle hitting the sign and whether the posts were NE or LE will be irrelevant provided they are lightweight passively safe and yield or fail in the impact as designed. Height is also most important and a heavy object can penetrate a vehicle windscreen if the object is low or the vehicle windscreen high.



Picture shows a LE Sign Post trial in Sweden where the Sign wants to go above the car while the mast underneath..... Note This is not a standard Lattix mast, but one we attached permanently to the foundation so it does break free on impact



Picture above including the diagrams showing the car speed reduction from 80 down to 20 km/h combined with low level of G-momentum on the driver during the collision (only 2.4g) shows a successful LE test of a standard Lattix 3325 short post which again was fixed permanently to the foundation (not standard). Actually the same mast, length and car speed as shown was used on the previous unsuccessful LE, but this time with no sign and weight fixed on top. Here we prove that the same Lattix mast can be NE, LE or HE depending how you fix it to the foundation and what you install on top.



Personally I would be terrified hitting something like this (a heavy VMS sign on rigid steel posts either of which represent an unacceptable risk)



Why not reduce the topside weight as absolutely much as possible and go underneath like this.

Question No 3

Are NE masts tested and approved at 100kph (including the 35 kph lower speed test) to EN 12767 suitable for use in urban areas and areas of lower speed limits or are further tests at 70 kph and 50 kph needed?

The answer is no. In my opinion an NE post tested at 100kph is suitable for use for all traffic speeds. The Scandinavian countries followed Table 7 – Hierarchy of Performance Types in EN 12767:2000. The table states a 100,NE,3 product includes approval to performance type 70,NE,3 and similarly a 100,NE,2 product includes approval to performance type 70,NE,2. Table 7 was drawn up to limit unnecessary testing. Table 7 may I understand be omitted from the forthcoming update to EN 12767. but in my view testing at 70 kph or 50 kph is still unnecessary and will not add to safety where an NE product is tested at 100kph and 35 kph. In Norway 100 NE approved masts, regardless of safety class, are used on all types of road in urban and country areas (although there are limitations on slip base products in urban areas).



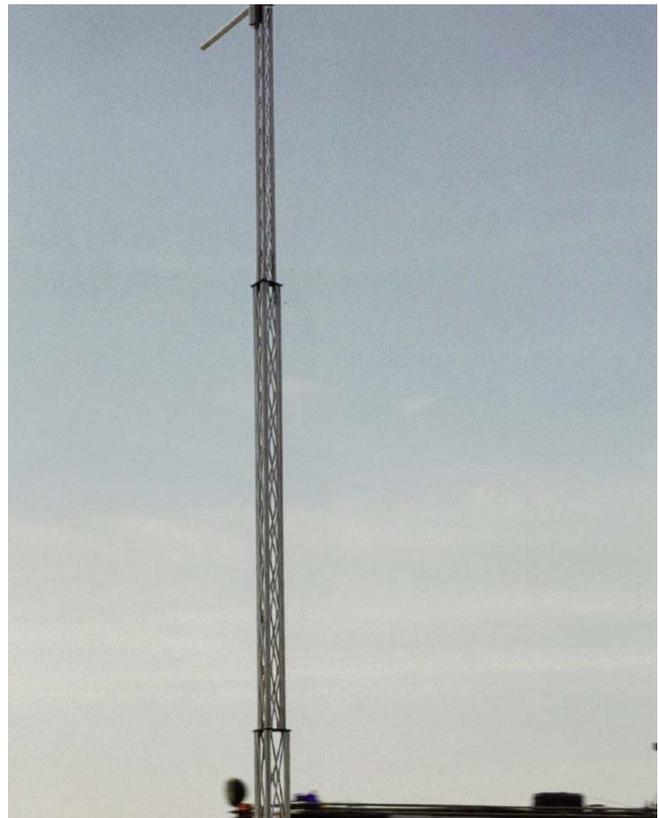
Lattix mast after 120 kph impact with aeroplane wing section

A 100 kph NE mast to EN 12767 will be tested at a low speed 35 km/h and 100 km/h. Our experience for Lattix (with more than 100 injury free accidents with our masts in Norway and over 30 in the UK) shows that a “soft” NE Mast is safe at all speeds. Used as a 14 metre Aviation Light column, we have successfully tested Lattix at speeds of 120 km/h with a thin walled sport airplane wing hit at a height of 4 metres with very little damage to the wing as shown in the photographs below.

For an NE product the low speed test (35 km/h) is the most difficult to satisfy and a product which satisfies this element of the test will probably pass a 100kph (and a 70 kph or 50 kph) test.

For the lower 35 kph speed test the car must not abruptly halt or bounce back or the THIV (Theoretical Impact Velocity) will exceed 27 kph. i.e. unless the car is not still moving forwards at least at 8kph when the theoretical head makes contact with the inside of the vehicle the test is a fail.

The high speed tests are easier to pass in this respect because higher THIV's are permitted and with the higher energies possessed by the vehicle the posts shear and fail with much less of a reduction to vehicle speed.



14 metre Lattix aviation mast before 120 kph impact with lightweight aeroplane wing section

In real life, accidents will occur at a variety of speeds with different cars, sometimes with posts on slopes where impact level may be very much different the EN 12767 test. The all round crash safety needed to cope with these varied impact conditions is achieved not only by meeting the EN 12767 test requirements but by having a product which is light in weight and soft or yielding when struck at any level. You are better off kicking an empty milk carton than you are kicking a brick with your bare foot.

It is important to ensure that any apparatus such as a VMS sign or traffic light head mounted on a mast or masts is light and readily deformable in a crash. This is much more relevant for safety than whether a mast is classified as NE, LE or HE. There is a need for guidelines on this so industry can develop suitable products for VMS signs and other roadside equipment.

Some final reflections

I think the important attributes of a mast are that it must be lightweight and yield readily in any accident. This is more important than NE LE and HE classifications or additional expensive crash tests at 50 and 70 kph speeds for 100 NE products. After more than 10 years of working with these issues, I wonder why road authorities in so many countries currently advocate HE, LE or NE masts depending on the various road types, locations and whether if it is rural or not.



Damage to light aircraft wing after 120 kph impact

For example the use of HE and LE masts is often recommended:

- a) where it is desirable to prevent an uncontrolled vehicle from continuing on to other hazardous obstacles such as trees, bridge supports, and rock faces (this is really asking the mast to do the task only a safety fence can reliably do).
- b) in built-up areas and other places with regular cyclists and/or pedestrian use; (this is prompted by fear of secondary accidents where a mast, sign or lighting column can hit vulnerable road users).
- c) on central reserves that are wide enough so a mast when hit (but anchored at its base) cannot fall across the path of oncoming vehicles in the other carriageway; (prompted by fear of secondary accidents).

Differences in the use of passively safe masts in Scandinavia and in the United Kingdom

EN 12767 gives guidelines, accepted throughout Europe, as to the testing and approval of energy absorbing equipment. Carrying out the tests, completing the test reports and seeking approval is time consuming and expensive. It is thus desirable to limit the number of crash tests to an acceptable minimum. With this in mind Norway took the initiative in the autumn of 1998 of establishing a Nordic group which was to cooperate in the testing and approval of energy absorbing passively safe street furniture.

On 29th January 1999 representatives from road authorities and testing laboratories from all the Nordic countries met in Oslo. There it was decided to establish a Nordic committee designed to cooperate in further work in testing and approving energy absorbing road equipment in accordance with EN 12767. When discussing where to use energy absorbing masts, the Nordic Group concluded the following:

It is recommended that energy absorbing sign masts and energy



A steel slip based mast which has been hit at a high level. The heavy mast failed to shear off and it can be seen the mast has not bent or distorted significantly. This will have been a very hard impact.

absorbing lighting masts are used on all important roads where there is a lot of traffic and where the speed limit is 50 kph. or greater. This will, of course, include all roads leading to and through towns, villages and other built-up areas. Boroughs should be encouraged to introduce these demands on local roads.

Energy absorbing masts should be employed in the following situations:

- *the building of new roads*
- *wherever new masts are being erected along existing roads*
- *a systematic renewing of equipment along existing roads*

These demands are not relevant where the masts are protected behind crash barriers or are otherwise situated that they do not constitute a hazard. The demands would still apply in those cases where a mast is situated behind a crash barrier but within the working width of the barrier.

Soft masts behind Barriers within its working width works.

We note that in Great Britain the use of passive safe masts is typically restricted to roads with speed limits over 50 mph (80 km/h).*



Why?

Our test experience shows that it's often the low speed tests that results the largest retardation on the driver (almost a sudden stop). From 35 km/h (23 Miles/h) and above a sudden stop can become fatal and indeed a large proportion of serious injury and fatal accidents from collisions with street furniture (and the resultant casualties) occur in urban areas in the UK.

* Editorial note: The 50mph UK practice was generated in 2004 in TA89/04 for UK trunk roads where the existing policy was to typically protect dangerous roadside obstacles with safety fences only where speed limits exceeded 50 mph. However any study of UK accident statistics will show urban areas have most injury with street furniture.

Safety levels, ASI and THIV

Safety levels are a very complicated matter even for specialists. Being a generalist I will therefore be careful and brief on this subject. Having looked into the NE, LE and HE classification System though, the safety levels should be addressed. The very simplified safety levels give us an idea of the retardation (the G forces) the driver suffers in the initial period when hitting a traffic mast.

Two theories are used which are derived from barrier testing in Europe and the USA.

In Europe we usually say that a driver can suffer a maximum of approx 12 g before the risk of suffering personal injury is overwhelming. In the United States a higher g force is allowed for a very short period of time.

EN 12767 uses both theories. THIV measures the speed an unrestrained body will impact the inside of the vehicle and this will limit how much a vehicle can be slowed in the short time before the body hits the inside of the vehicle. The ASI relates to the deceleration forces the driver suffers.

The test to EN 12767 typically uses older Ford Fiesta and sometimes Suzuki Swift cars. They are light and represent the smaller vehicles (but not smallest) on the road. It is probably fair to say it modern equivalent cars will tend to be heavier, stronger and will safely absorb more energy in an impact so the test may be severe. Lattix products to EN 12767 have an unblemished safety record and I understand some competitors may also perform well. The test does have a good record in developing safe products (with the possible exception of slip based products)

Paradoxically a car with a rigid bumper encouraging a post to shear on impact may fair better than a car with a soft bumper in a NE crash test as there is no requirement to reduce vehicle speed in the NE classification. If a car was soft at the front so it did not readily shear a post, it might fair better in a LE or HE test where the post must not shear off as it is needed to deform over its length and thus absorb energy and slow the vehicle.

In my view some energy absorption is essential even in a NE product if only because the mast must not bounce when struck and this should be part of the test. One should in my opinion, at this early stage, be careful complicating matters, introducing safety levels as a classification system in National Annexes. They can, in some cases, be very misleading. In Norway safety levels are not introduced in the exiting handbook 062 which regulates the use of EN 12767 approved masts.





How Norwegians apply passive safety

In Norway most passively safe masts are installed on ordinary single carriageway roads often where speed limits are 80 kph or less and in urban areas. Of course they are still used on our motorways but most roads in Norway are not 4 lane motorways or dual carriageways.

The Handbook 062 (National Guidelines for the use of EN 12767 Masts) states that passively safe masts should always be used in a safety zone next to the carriageway regardless of type of road. The safety zone width depends on the speed limit and is:

- 3 metres where speed limits are 50 kph or less
- 4 metres where speed limits are 60 kph
- 6 metres for speed limits of 70km/h and 80 km/h
- 7 metres for higher speeds than 80 kph

Road designers, Contractors, County Councils have tended to standardize on selected passively safe products for logistical reasons.



Perhaps as much as 60 – 70% of passively safe masts are used on single carriageway roads including roads in urban areas. In Norway all passively safe signposts are NE (including two NE slip based masts which are subject to extra limitations and not permitted in urban areas). Only NE masts have been used as Signal masts, but still traditional “not approved” signal poles are mostly used, especially on smaller installations. NE and HE classes are used for lighting columns. Here both traditional steel posts with slip base and modern thin walled roll form steel tube and thin walled aluminium tube columns are in use.

In Oslo and other Scandinavian urban areas more than one thousand lightweight yielding NE posts have been installed without any reports of primary or indeed secondary fatal accidents in the last 10 years. Many of the posts are in the centre of Oslo where there are numerous pedestrians.



Pictures of passively safe NE masts in use in urban areas



Sign and mast falling close to its original position after impact

Secondary accidents or their absence

I can only answer for Lattix but we have had no report of any fatalities or serious casualties in secondary accidents (or indeed primary accidents) with our product in over 10 years of use.

About 30,000 Lattix masts are installed in Norway and 20% are probably in urban areas. Typically these Lattix masts support signs, traffic light heads or similar street equipment. All the Lattix masts are lightweight yielding NE products. Lattix masts are widely used on country roads where Norwegian speed limits are generally 80 kph as well as higher speed motorways.

The risk of “lightweight yielding” NE products causing secondary to pedestrians or cyclists as identified in national application documents is in my view much overstated and counterproductive in safety terms. Secondary accidents are so rare that nobody has reported one to our product.

I believe this is because:

- Lattix posts are lightweight and yielding (these characteristics are I believe more important than whether they are of NE or LE classification)
- Signs and signal head mounted on top are normally lightweight
- The construction itself being light and yielding so posts usually fall close to the point of collision (this can be seen in the Lattix EN 12767 crash tests)
- Signs and signal masts are normally on the roadside so the risk of a sign falling into the roadside and being hit by a following car is low

It is argued that because HE and LE products can stop or slow a car they will prevent a vehicle hitting vulnerable pedestrians. This may happen if the vehicle is not too heavy but in the case of a glancing blow or heavy vehicle it makes little difference. Relying on isolated posts to safeguard pedestrians by slowing or catching vehicles is at best a highly uncertain safety fence.

Different considerations apply to HE and LE lighting columns where a long HE or LE lighting columns wrapping round the vehicle in an impact rather than falling across a crowded footpath or busy road may be a welcome virtue.

Conclusions

- To demand in national annexes that LE posts are used for signs in built up or low speed areas is probably not the best way forward. To make this physically achievable it is probably necessary to provide two LE posts to each sign.
- However, lightweight deformable energy absorbing NE posts are inherently safer for the errant vehicle than a steel post (or a HE or LE post).
- Because lightweight deformable energy absorbing NE posts fall close to the point of impact the chance of a secondary accident is very low indeed (and as the masts are comparatively light and deformable such an accident may well not be serious).
- Designing a LE mast for mounting traffic signals is more easily achievable than for signs. We concur the LE class is suitable for mounting traffic signals in urban areas.
- We would also agree it is reasonable to use HE masts for lighting columns in built-up areas where the speed limit is normally 50 k.p.h. or 60 k.p.h. and to use LE and NE for lighting columns and NE masts for signs outside built-up areas where the speed limit is 70 k.p.h. or more.
- We advise that NE classified Products be divided in two categories lightweight energy absorbing products which should be judged suitable for urban areas and slip based products which in Norway would not be used in urban areas (or on a slope).
- The problem in achieving a LE or HE rating will be common to all lightweight energy absorbing passively safe signposts.
- Those specifying passively safe masts as signposts or traffic signal posts should be careful to ensure signs or signals attached to them are lightweight and yield on impact. This is probably more important than whether the masts are LE or NE. In particular VMS signs can be heavy and a real danger if they are at windscreen height of any vehicle.