FINNISH ROAD ADMINISTRATION

Finnra Engineering News No 12A

Published by Finnish Road Administration, Technical Services, 18 February, 2003

VERTICAL SIGN SUPPORT WITH PASSIVE SAFETY, YEAR 2002

New

The latest version of this publication 12B, 12C etc. is available in internet: www.tiehallinto.fi/finnra.htm.

The publication includes information about quality reguirements of impact safe support structures for vertical signs and about products that have been tested.

Approval

Support structures of vertical signs are tested according to EN 12767 (Passive safety of support structures for road equipment – Requirements and test methods).

Products are classified into performance types based on three factors:

a. Speed class (impact speeds used in the test)
b. Effect of the impact upon the speed
   HE (high energy absorbing) = slows the vehicle considerably
   LE (low energy absorbing) = slows the vehicle to some extend
   NE (non-energy absorbing) = slows the vehicle slightly or not at all

Table 1. Energy absorption categories.

Impact speed (km/h)	50	70	100
	Exit speed (km/h)		
HE	v = 0	0 ≤ v ≤ 5	0 ≤ v ≤ 50
LE	0 < v ≤ 5	5 < v ≤ 30	50 < v ≤ 70
NE	5 < v ≤ 50	30 < v ≤ 70	70 < v ≤ 100

c. Level of occupant risk (Occupant safety level)
   Occupant safety levels 1 – 3: Level 1 the highest risk, level 3 the lowest risk
   Level 4: Unharmful, light support structures

The performance type of the product according to the standard may thus be e.g. 100,NE,3. This means that the product has been tested using impact speeds 100 km/h and 35 km/h. Exit speed after the impact (impact speed 100 km/h) has been 70 - 100 km/h (NE). Occupant safety level is 3. The occupant

safety level is determined by changes in accelerations and velocities during the test.

At present a Nordic approval policy is used until a new European approval policy takes effect in 2003 (or 2004).

During the transition period it is sufficient to deliver the application with impact test reports to the road authorities in one of the Nordic countries, preferably in the home country of a producer. The approval of passive safety in one Nordic country is valid in all Nordic countries (Finland, Sweden, Denmark and Norway).

The current policy of the transition period will change when the annex ZA of EN 12899-1 (Fixed, vertical road traffic signs) according to Construction Product Directive and approval instructions becomes finalized. The annex ZA will include among other things information about CE-mark and approval institutions.

Impact safety

In Finland support structures of vertical signs are classified into the following categories based on passive safety:

A. Products with passive safety according to EN 12767: The product or the largest version of it has been tested and approved according to the standard.
   - Products of the classes HE100,3; LE100,3 and NE100,2…3 may be used on all roads
   - Products of the classes HE70,3; LE70,3 and NE70,2…3 may be used on roads with speed limit 80 km/h or less
   - When a sign is located between a road and a pedestrian- and bicycle way, it should be considered to use a structure of the classes HE or LE, which slows down the speed of a vehicle. At present there are no HE- or LE-products on the Finnish market.

B. Borderline cases that don't meet all the requirements above, but which have not caused many personal injuries. E.g. support structures with two or three 114 mm pipe posts in concrete base.

C. Clearly dangerous structures: Cantilever and gantry supports, support structures with four or more 114 mm pipe posts and other structures, that have stiffer than 120 / 3 mm steelpost without special safety device.

On roads with high traffic volume new signs are equipped with structures of category A. Alternatively structures shall be placed far enough from the road or behind a barrier with sufficient length.

On roads with a little traffic or low speed level (under 1500 vehicles/day or speed level not more than 50 km/h) also the borderline cases of category B may be used.

The basic cases of impact safety support structures for vertical signs are:

- One steel column or lattice post with a slipbase and a normal sign panel

- One or two lattice posts with a panel, which are both tested in a vehicle impact test
- Two hollow wooden posts at least 2 meters away from each other, if catching on two posts at same time may be dangerous (wooden posts should not be used with high sign panels).

Design of the structures

Design of the structures can be done with Opta2.xls, which is a calculation sheet created with MS Excel 97 spreadsheet program. (www.tiehallinto.fi/finnra.htm, Link: opta2e.zip).

The calculation sheet has six forms: Design, Offer Request, Capacity, Installation, Standard Shape Sign Face and Principle Drawing.

The Design form is filled in by the road designer. Input data includes e.g. size and location of the sign and the maximum speed of the snow plough. Based on the data provided the calculation sheet computes the forces and moments acting on the post. The forces and moments in the ultimate limit state are displayed in the maximum loading columns (Load factor = 1,5).

The Offer Request form is filled in by the manufacturer of the support construction or subconstructor submitting an offer to the main constructer. The “Required”-column displays the required properties of the support construction as well as the force and moment actions acting on it and stiffness requirements copied from the Design form. The properties and resistances of the proposed support construction are entered into the “Selected”-column. On the Offer Request form there is also a column for performing a comparison between the required and selected capacities of a single support.

The Capacity form and the Installation form are filled in by the structural engineer. The Principle Drawing form is used to verify the geometry of the entered source data.

Products

Products have been classified to lattice masts and pipe profile posts. Lattice masts may bend in consequence of the impact or be equipped with a slipbase. Pipe profile posts are usually equipped with a slipbase.

Lattice masts

Juralco As, Norway (fax: +47 67178571, E-mail: kim.heglund@juralco.no) produces,
Elfving Oy (fax: 019 7866100, E-mail: krister.langbacka@elfving.fi) sells:

- LATTIX- aluminium masts that are fastened to concrete foundation, which belongs to the product.
    - In the impact the structure bends or breaks.
    - The performance in the slope (1:3 – 1:2) is more reliable than one of a slipbase.
    - Signs: Only aluminium panels specified by the producer are used. The sign shall bend like the lattice in an impact.
    - Foundation: A concrete foundation with bolts installed in it. The lattice can be easily adjusted in the vertical position.
    - Impact tests have been done with 1- and 2-support structures. When two or more supports are needed, the distance between supports must be at least 1,5 meters.
    - Have been used in Norway (several hundreds of supports) and in Finland (dozens of supports).
    - Approved in Norway in the year 2000.

Figure 1: LATTIX-support

Meag Genevad AB, Sweden (fax: +46 221 23436, E-mail: anders.bladh@meag.se) produces,
Elfving Oy (fax: 019-7866100, E-mail: krister.langbacka@elfving.fi) sells:

- Steel lattice mast with a slipbase.
    - In the impact the slipbase goes off and the sign falls down behind the vehicle.
    - Signs: Aluminium profile panels are recommended, but also a rigid sign may be used, because the support doesn't bend.
    - Foundation: A concrete foundation with a fastening plate for slipbase.

- Impact tests have been made with 1-support structures.
- Only one support per sign may be used.
- Have been used in Sweden and Finland (main road no 3).
- Approved in Sweden in 2000.

Eltel Networks AB, Sweden (fax: +46 8 4445599, E-mail: mikael.stahl@eltelnetworks.se) manufactures and sells,
e.g. *Potila Oy* (E-mail: potilakokemaki@potila.fi/ risto.peltomaa@potila.fi) produces:

- Steel lattice masts with a slipbase.
  - Foundation: A concrete foundation. On the foundations of bigger supports (width: 450 and 380 mm) there is a fastening plate, slipbase of smaller support (width: 295 mm) is fastened to the bolts in the foundation.
  - Impact tests have been made with 1-support structures, new standards provide additional tests.
  - Have been used in Sweden.
  - Approved in Sweden in 1997.

Blinkfyrar AB, Sweden (fax: +46 46 252683) produces,
Laatukilpi Oy (fax: 06-4822210, E-mail: stefan.storgard@laatukilpi.fi) sells:

- Steel lattice masts with a slipbase.
  - Foundation: A concrete foundation on which the lower part of slipbase is fastened.
  - Have been used in Sweden, marketing in Finland started in 2002.
  - Approved in Sweden.

Pipe profile posts

Meag Genevad AB, Sweden (fax: +46 221 23436, E-mail: anders.bladh@meag.se) produces;
Elfving Oy (fax: 019-7866100, E-mail: krister.langbacka@elfving.fi) sells:

- Square profile post with a slipbase.
  - Foundation: A concrete foundation with a fastening plate for slipbase.
  - Signs: Aluminium profile panels are recommended, but also rigid sign may be used.
  - Impact tests have been made with 1-post structures.
  - Have been used in Sweden.
  - Approved in Sweden in 2000.

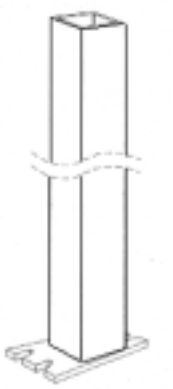

Figure 2. Square profile post (Meag Genevad)

Nor-Skilt, Norway (fax: +47 51578760, E-mail: terje.hansen@nor-skilt.no) produces and sells in Norway:

- T&V aluminium profile post with a slipbase.
  - Foundation: A concrete foundation with holes to set a fastening plate. Slipbase is fastened to the plate. Fastening plate can be adjusted to bases of other producers.
  - Impact tests have been made with 1-post structures.
  - Have been used in Norway (hundreds of posts) and in Denmark (dozens of posts).
  - Approved in Norway in 2001.

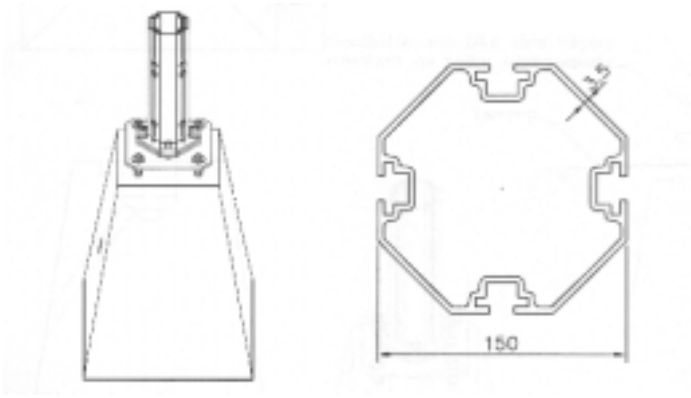

Figure 3. Aluminium profile post (Nor-Skilt)

Eltel Networks AB, Sweden (fax: +46 8 4445599, E-mail: mikael.stahl@eltelnetworks.se) manufactures and sells:

- V05-square profile post with a slipbase.
    - Foundation: A concrete foundation on which the lower part of slipbase is fastened. The lower part of slipbase is also produced as a separate product which may be fastened to bases made by other producers.
    - The product has been tested according to prEN 12767, it may be approved also according to EN 12767 without additional tests.
    - Have been used in Sweden.
    - Approved in Sweden.

Blinkfyrar AB, Sweden (fax: +46 46 252683) produces,
Laatukilpi Oy (fax: 06-4822210, E-mail: stefan.storgard@laatukilpi.fi) sells:

- KKR-square profile post with a slipbase.
    - Foundation: A concrete foundation on which the lower part of slipbase is fastened.
    - The product has been tested according to prEN 12767, approved according to EN 12767.
    - Have been used in Sweden 2000 – 3000 posts, marketing in Finland started in 2002.
    - Approved in Sweden.

Tehomet Oy (fax: 015-7800777, E-mail: pentti.kettunen@tehomet.fi) produces and sells:

- Round profile steelpost with slipbase.
    - Foundation: A concrete foundation.
    - The product has been approved based on impact test with vertical signs (35 km/h). During the transition period the product may be used in Finland.
    - Have been used in Finland (dozens of posts).

FINNISH ROAD ADMINISTRATION / Vertical sign supports with passive safety, year 2002						
Company / products	Product properties				Impact safety	
	M_u (kNm)	M_{vu} (kNm)	EI (kNm^2)	GI_v (kNm^2)	Perform-ance type	Maximum size of the sign
LATTICE MASTS						
Juralco As:						
LATTIX-aluminium lattice masts						
- C 3320 (triangle profile, side: 200 mm)	15,7	1,38	252	20	100,NE,3	2,6 m^2, 26 kg
- C 3325 (triangle profile, side: 250 mm)	30,9	1,56	598	28	100,NE,2	5,4 m^2, 59 kg
- C 4420 (square profile, side: 200 mm)	27,8	1,96	675	35	100,NE,3	3,8 m^2, 37 kg
- C 4425 (square profile, side: 250 mm)	80,2	4,87	1506	109	100,NE,2	7,3 m^2, 80 kg
- C 4438 (square profile, side: 380 mm)	147,6	14,88	4330	507		
- C 3320 x 2 (two supports)					100,NE,3	No limitation
- C 3325 x 2 (two supports)					100,NE,2	No limitation
- C 4420 x 2 (two supports)					100,NE,3	No limitation
- C 4425 x 2 (two supports)					100,NE,2	No limitation
	When two or more supports are needed, the distance between supports must be at least 1,5 meters.					
Meag Genevad AB:						
Steel lattice masts with a slipbase						
- Type 1, (A) (square profile, side: 450 mm)	169,5	28,0	19400	2697	100,NE,2	25,3 m^2, 290 kg
- Type 2, (B) (square profile, side: 380 mm)	100,5	27,2	13506	2070	100,NE,2	25,3 m^2, 290 kg
- Type 3, (C) (square profile, side: 295 mm)	54,1	12,4	7947	907	100,NE,2	20,0 m^2, 240 kg
	The largest size tested, two versions: 1- / 2- way roads.					
Eltel Networks TE AB:						
Steel lattice masts with a slipbase						
- Type A (square profile, side: 450 mm)	176,7				100,NE,3	24,6 m^2, 300 kg
- Type B (square profile, side: 380 mm)	81,56				100,NE,3	24,6 m^2, 300 kg
- Type C (square profile, side: 295 mm)	45,36				100,NE,3	24,6 m^2, 300 kg
Blinkfyrar AB:						
Steel lattice masts with a slipbase						
- square profile, side 450 mm	148	27	34200	3737	100,NE,2	24 m^2, 294 kg
- square profile, side 380 mm	86	10	18670	1433	100,NE,2	24 m^2, 294 kg
- square profile, side 295 mm	47	9	8971	788	100,NE,2	24 m^2, 294 kg
	The largest size tested.					
PIPE PROFILE POSTS						
Meag Genevad AB:						
Square profile posts with a slipbase						
- KKR 80 x 80 x 4	9,5	7,9	235	143	100,NE,3	10,2 m^2, 166 kg
- KKR 100 x 100 x 5	15,9	14,3	509	343	100,NE,3	10,2 m^2, 166 kg
- KKR 120 x 120 x 4	18,0	16,1	751	495	100,NE,3	10,2 m^2, 166 kg
Nor-Skilt:						
T&V aluminium profile posts with a slipbase						
- T&V 0173 (width: 120 mm)	8,0	8,0			100,NE,2	
- T&V 0186 (width: 150 mm)	17,7	14,0			100,NE,2	
- T&V 0164 (width: 190 mm)	29,3	31,0			100,NE,2	188 kg
	The largest size tested.					
Eltel Networks TE AB:						
Square profile posts with a slipbase						
- V05 105 (side: 80 mm)	10,0					
- V05 104 (side: 100 mm)	19,1					
REMARK: Grey areas: Not known or uncertain information concerning the moment capacity of the slipbase.						

FINNISH ROAD ADMINISTRATION / Vertical sign supports with passive safety, year 2002						
Company / products	Product properties				Impact safety	
	M_u (kNm)	M_{vu} (kNm)	EI (kNm^2)	GI_v (kNm^2)	Perform-ance type	Maximum size of the sign
Blinkfyrar AB:						
KKR square profile posts with a slipbase						
- KKR 120 x 120	33,9	26,0	1019	630	100,NE,3	6,2 m^2, 77 kg
- KKR 100 x 100	18,9	14,5	475	293	100,NE,3	6,2 m^2, 77 kg
- KKR 80 x 80	11,8	8,9	233	146	100,NE,3	6,2 m^2, 77 kg
Tehomet Oy:						
Round profile steelpost with a slipbase (The capacity is not known). (According to drawings of Finnish Road Enter-prise)					100,NE,3	
	Properties of steelposts below.					
Calculated capacities						
RIGID LATTICE MASTS: According to drawings of Road Administration						
- RT1	112,6	18,6	15088	2522		
- RT2	172,7	18,6	18215	2574		
- RT3	244,5	38,3	25663	4021		
- RT21	112,6	6,8	11794	1452		
- RT22	172,7	18,6	18215	2574		
- RT23	244,4	18,8	21082	2630		
PIPE PROFILE STEELPOSTS						
- S355: 60,3 / 2,0	1,7	2,0	33	25		
- S355: 88,9 / 2,0	3,7	4,4	108	83		
- S355: 114,3 / 2,0	6,3	7,4	233	179		
- S355: 159,0 / 4,0	23,8	28,1	1229	945		
- S355: 168,3 / 4,0	26,7	31,6	1463	1126		
- S355: 219,1 / 4,0	46,1	54,2	3284	2526		
- S355: 273,0 / 4,0	72,3	84,7	6422	4940		
WOODEN POSTS						
- Wooden post 270 / 30						
- Time class A (Structures own weight)	15,9	3,2	645	63		
- Time class B (load from snow clearance)	20,8	4,2	860	84		
- Time class C (wind load)	24,5	4,9	1075	105		
REMARK: Grey areas: Not known or uncertain information concerning the moment capacity of the slipbase.						

Previous numbers:

1. Break-away lighting columns, current practice in Finland in 1993
2. Foundations of luminaire supports. The effect of backfill on strains in foundations.
3. The need of space for snow remover from carriageways in Finland
4. Acoustic performance of simple board and plywood
5. Break-away lighting columns, current practice in Finland in 1996
6. Break-away lighting columns, current practice in Finland in 1998
7. The effect of openings on the insertion loss of noise barriers
8. Improving roadside safety on old roads

9C. Break-away lighting columns in Finland, year 2001

10A. Opta2e.xls tool for design of supports for vertical signs

11A. Safety effects of installing new guardrails and improving existing guardrails

---

Finnra Engineering News No 12A

VERTICAL SIGN SUPPORTS WITH PASSIVE SAFETY, YEAR 2002

New edition: www.tiehallinto.fi/finnra.htm.

Further information: Jyrki Soukiala, YS-Konsultit Oy
Tel. +358(0)9 25336300, fax: +358(0)9 25336310,
E-mail: jyrki.soukiala@ysyh.fi

Kari Lehtonen, Finnish Road Administration / Technical Services
Tel. +358(0)204 22 2317, fax: +358(0)204 22 2312
E-mail: kari.lehtonen@tiehallinto.fi