

JCT 2013

Passive Poles – Active Thinking

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Presentation content



- Detailed look at the new Siemens design and risk assessment process for passively safe systems
- Detailed look at the new Siemens structural analysis process for passive poles
- Other equipment considerations
- The Siemens Passively Safe Systems project
- Questions

Some provocative statements!

Passive safety at traffic signals is expensive and a waste of taxpayers money!

The use of passively safe poles create more risks than they solve!

Passively safe solutions are rarely installed properly and consequently don't really perform!

Passive poles are weak and will fall over in strong winds!

Like all such statements these contain an element of truth, but the **correct and appropriate use** of passively safe solutions at traffic signals can improve overall safety



Some issues

Extensive published material on this topic exists

But often the full implications of using passive poles are still not well understood by many

Some perceived problem areas:-

- Lack of knowledge of the subject and real understanding of all the practical product limitations, particularly basic pole strength
- Blinkered implementation, where full account of all risks are not fully understood or considered when selecting pole types





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Risk Assessment

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Traffic signal design

The designer of a traffic signal control scheme is required to consider all potential proven alternatives for a particular component and select an option with the aim of ensuring that risks are kept as low as reasonably practicable

The designer should prepare risk assessments for all aspects of the system and its physical and human context throughout the complete life cycle

 Construction, installation and testing to operation, maintenance and eventual decommissioning.



Traffic signal design





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Pole choice



How should a designer decide on a pole type?

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Pole choice

Considerations

- Location of the pole
- Speed of the road
- Volume of road users; vehicles, cyclists, pedestrians
- Required equipment on the pole
- Mounting of equipment
- Structural integrity of the pole
- Pole installation
- Electrical connection
- Associated equipment
- Cost
- Future maintenance





Pole choice

Risk assessment

Assessment of pole type against different risk events to determine a Risk Factor

Risk Factor = Severity x Likelihood

- Severity Factor calibrated over number of schemes to provide un-biased approach
- Likelihood assessed by the designer

1	Hazard Category	1. Aggressi signal	veness of pole	2. After pole or h	e obstruction azard		3. Contin	uing vehicle			4. Fal	ing or collapsi	ng pole (dy	namic)				5. Fallen po	ole (static)	
2	Flisk Event	11 Vehicle leave and collides	es carliagevag s vith pole.	2.1 Vehicle leav collides w continues y secondary ha change in le another carria seconda	uing carriageway ith pole and passage into scard such as a evels, a bank, ageway or other ary hazard.	3.1 Vehicle 6 collides continue opposite continuin present a ho of other ve involved accident. original vehi capi	eaving cantageva s with pole and es passage into cantageway. The ng vehicle could azard to occupant kicles who maybe din a secondary . (The risk to the cles occupants at tured in 2.1)	9 32 Vehicle le collides / continues pas non-mot	aving carriagevaa eith pole and Isage into area o orised users.	4.1 After a coll pole and a vehi onto othe	sion between a sle the pole falso r vehicles.	42 After a collis pole and a vehicle or to a vehicle transport mode	ion between a le the pole falls e on another such as LRT.	4.3 After a col pole and a vehi onto Non-mo	lision between a cle the pole falls storised users.	51 Yehicles co pole on the	slide vith fallen • cantiagevag	5.2 LRT or of vehicles collide has fallen on ro transpor	ther non road with pole which ute of the other ft modes.	i 5.3 Non-w
3		Impact	speed	Impac	t speed	iπρ	oact speed	Impa	ct speed	Impad	speed	Impact s	speed	Inpac	t speed	Іпрас	t speed	Inpac	tspeed	'n
4		Aggressiven	ess of pole	Pole	rating	P	olerating	Pol	erating	Pole	rating	Polera	aling	Pole	rating	Pole	rating	Pole	rating	F
5	Contributing	Line of sig	ht of pole	Proximity of se (exit:	econdary hazard speed)	Proximity of (et	f secondary hazan iit speed)	i Density c occupants in	ł non-vekicle proximity to pole	Proximit cantagevag	y of other s (exit speed)	Preaimity of off mode	her transport les	Density of occupants	non-vehicle r in range of	Proximit carriagevag	iji of other is (enit speed)	Proximity of a ma	xhertransport odes	Densit
6	Factors	Distance of po	ole hom kerb	Yolume	of traffic	Type of g car	pround between riageways			Volume	oftraffic	Volume of oth transport	er traffic on modes	Trałic signal e P	quipment on the sle	Volume	ofitratiic	Yolume of ol transpo	cher traffic on et modes	
7	1									Distance of p	ole from kerb	Distance of po	ile from kerb			Pole location from	n and distance n kerb	Pole location from	n and distance n kerb	
8										Traffic signal er pc	quipment on the sle	Traffic signal equ pole	uipment on the e							
9		Non Passive	Passive	Non Passive	Passive	Non Passi	ive Passive	Non Passiv	e Passive	Non Passive	Passive	Non Passive	Passive	Non Passive	Passive	Non Passive	Passive	Non Passive	Passive	Non Pass
10	Pole Number	Severity Likelihood (1-5) Flizk Factor	Severity Likelihood (1-5) Risk Faotor	Severity Likelhood (1-5) Risk Factor	Severity Likelhood (1-5) Flirk Factor	Severity Likelihood (1-5)	Fisk Factor Severity Likelihood (1-5) Fisk Factor	Severity Likelhood (1-5) Flick Factor	Severity Likelhood (1-5) Fliak Factor	Severity Likelihood (1-5) Fisk Factor	Severity Likelihood (1-5) Pijsk Faotor	Severity Likelhood (1-5) Flick Factor	Severity Likelihood (1-5) Fisk Factor	Severity Likelihood (1-5) Risk Factor	Severity Likelihood (1-5) Flirk Factor	Severity Likelihood (1-5) Fisk Factor	Severity Likelihood (1-5) Risk Faotor	Severity Likelihood (1-5) Flisk Factor	Severity Likelihood (1-5) Flirk Factor	Severity Likelihood (1-5)
11		4	4	4	5	4	5	1	2	3	4	1	0	1	1	3	4	0	0	
12		5	5	4	5	4	5	1	2	3	4	1	0	1	1	3	4	0	1	1
13		4	4	3	4	4	5	1	2	3	4	1	0	1	1	3	4	0	1	1
14		5	5	4	5	4	5	1	2	3	4	1	0	1	1	3	4	0	1	1
15		4	4	3	4	3	4	3	1	3	4		0	3	3	3	4	0	1	2
16		5	5		2	2	3	4	5	2	3	1	0	3	4	2	3	0	0	2
11		9	0		1		Z				4		- U - S		1 2	1	1 1 N 1			2

Further considerations

Determine the size of each traffic signal pole based on:

- Wind pressure at a particular site
- •The configuration of signal equipment mounted on the pole

Design summary

Pole choice is an important part of the overall traffic signal design process

Scheme designers should be satisfied that they have used a robust method to determine and record pole type choice

Full documentation of the desired pole type within the design will help to ensure that the design is correctly implemented by the installation company

Siemens designers are using a risk assessment based process to determine pole type and further design tools to assess structural suitability of passive poles





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Structural strength assessment

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Relative pole strengths

The Industry is used to steel poles, without access doors

'These are strong in bending and torsion so have few limitations in the UK at 4m height'



- Low level access door cut-outs significantly reduce the pole strength, especially in Torsion
- Materials used for Passive Poles are generally weaker
- EN40, which is widely used to calculate door aperture strength, over estimates Torsional strength





Ordnance Survey[®]

Wind Loads vary significantly throughout the UK

Wind Pressures affected by:

- Basic wind speed
- Altitude
- Distance to coast
- Height above ground
- Orography
- Terrain category



Fort William

Close to exposed coast High basic Wind speed



Oxford

Built up location Low basic Wind speed Long distance from exposed coast



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Forces exerted by traffic signals

- A lot of published data is available for the shape factors (drag) to use for various sized signs and poles
- Very little data available for the wind loads generated by traffic signals
- Engineers used Shape factors (Cd) ranging from 1 to 1.8 to calculate loads
- Inconsistency gave very different answers when it came to specifying suitable poles
- Decided to carry out detailed wind tunnel testing out at the University of Southampton's RJ Mitchell tunnel
- Numerous configurations of signal head were tested at varying wind speeds and incident angles



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SF (m²) ST (m³)

Making sense of the Wind Tunnel data

From the data obtained at the wind tunnel, we have extrapolated the loads, for the most common configurations, in terms of:

Specific Force (SF)

Specific Torque (ST)

These figures are forces per unit of wind pressure so they can be easily applied to any application in the UK.

Calculation for 1x3 & 3+1 signal (Assumed wind pressure for location = 900Pa)

Specific Force $_{(1x3)+(3+1)}$ (SF) = 1.16m² Specific Torque $_{(1x3)+(3+1)}$ (ST) = 0.29m³



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1	17	No Equipment Fitted	0	0
2	18	1x3	0.64	0.14
3	19	2x3	0.94	0.21
4	20	3x3	1.77	0.31
5	21	4x3	1.77	0.31
6	22	1x4	0.87	0.16
7	23	2x4	1.28	0.24
8	24	3x4	2.41	0.35
9	25	4x4	2.41	0.35
10	26	1x(3+1)	0.86	0.22
11	27	2x(3+1)	1.26	0.33
12	28	3x(3+1)	2.37	0.49
13	29	1x3 + (3+1)	1.16	0.29
13 14	29 30	1x3 + (3+1) 2x3 + (3+1)	1.16 1.99	0.29 0.39
13 14 15	29 30 31	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1)	1.16 1.99 1.99	0.29 0.39 0.39
13 14 15 16	29 30 31 32	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1)	1.16 1.99 1.99 1.27	0.29 0.39 0.39 0.33
13 14 15 16 17	29 30 31 32 33	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1)	1.16 1.99 1.99 1.27 2.41	0.29 0.39 0.39 0.33 0.41
13 14 15 16 17 18	29 30 31 32 33 34	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1)	1.16 1.99 1.99 1.27 2.41 2.41	0.29 0.39 0.39 0.33 0.41 0.41
13 14 15 16 17 18 19	29 30 31 32 33 33 34 35	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1) 1x3 + 1x4	1.16 1.99 1.99 1.27 2.41 2.41 1.28	0.29 0.39 0.39 0.33 0.41 0.41 0.24
13 14 15 16 17 18 19 20	29 30 31 32 33 34 35 36	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1) 1x3 + 1x4 1x3 + 2x4	1.16 1.99 1.99 1.27 2.41 2.41 1.28 2.41	0.29 0.39 0.33 0.41 0.41 0.24 0.35
13 14 15 16 17 18 19 20 21	29 30 31 32 33 34 35 36 37	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1) 1x3 + 1x4 1x3 + 2x4 1x3 + 3x4	1.16 1.99 1.99 1.27 2.41 2.41 1.28 2.41 2.41 2.41	0.29 0.39 0.33 0.41 0.41 0.24 0.35 0.35
13 14 15 16 17 18 19 20 21 22	29 30 31 32 33 34 35 36 37 38	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1) 1x3 + 1x4 1x3 + 2x4 1x3 + 3x4 1x4 + 2x3	1.16 1.99 1.99 1.27 2.41 2.41 1.28 2.41 2.41 2.41 2.00	0.29 0.39 0.33 0.41 0.41 0.24 0.35 0.35 0.33
13 14 15 16 17 18 19 20 21 22 23	29 30 31 32 33 34 35 36 37 38 39	1x3 + (3+1) 2x3 + (3+1) 3x3 + (3+1) 1x4 + (3+1) 2x4 + (3+1) 3x4 + (3+1) 1x3 + 1x4 1x3 + 2x4 1x3 + 3x4 1x4 + 2x3 1x4 + 3x3	1.16 1.99 1.99 1.27 2.41 2.41 1.28 2.41 2.41 2.41 2.00 2.00	0.29 0.39 0.33 0.41 0.41 0.24 0.35 0.35 0.33 0.33
13 14 15 16 17 18 19 20 21 22 23 24	29 30 31 32 33 34 35 36 37 38 39 40	$ \begin{array}{c} 1x3 + (3+1) \\ 2x3 + (3+1) \\ 3x3 + (3+1) \\ 1x4 + (3+1) \\ 2x4 + (3+1) \\ 3x4 + (3+1) \\ 1x3 + 1x4 \\ 1x3 + 2x4 \\ 1x3 + 2x4 \\ 1x3 + 3x4 \\ 1x4 + 2x3 \\ 1x4 + 3x3 \\ 1x(4+1) \end{array} $	1.16 1.99 1.99 1.27 2.41 2.41 1.28 2.41 2.41 2.41 2.00 2.00 1.08	0.29 0.39 0.33 0.41 0.41 0.24 0.35 0.35 0.35 0.33 0.33 0.26

Configuration

Case Table

Calculating pole suitability





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Next steps

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Other "thorny" issues to be resolved

Electrical disconnection systems

• Are these really necessary, what are they trying to protect against?

Physical break-away systems

 Is it reasonable to install passive poles without physical breakaway systems or should these always be used?

Opinion is widely divided on these topics but a degree of rationality needs to be brought to the discussion

Do you have evidenced views to help clarify thoughts in this area?



Bringing it all together The Siemens Passively Safe Systems Project

Aims of the project

Research and work with suppliers to agree set of acceptable poles to be used (from a structural viewpoint)

- Ensure that passively safe sites are not only safer for drivers, but also meet the structural requirements of BS EN 12899
- Help designers understand how to use our Wind Tunnel data (available from <u>http://www.siemens.co.uk/traffic</u>)
- Streamline the design processes to make it is easier to select the correct traffic signal poles without requiring a deep technical knowledge

Research and agree full set of associated equipment

 Seek guidance and advice from current users, suppliers and the HA

Finalise the Siemens design and specification process for passively safe systems

• Publish as 'best practice' to be used by Industry if desired

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Questions?



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