

An Exploratory Study of the Impact and Construction of Billboards and Signage Structures

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ABSTRACT

Many typhoons struck the Philippines and damaged the billboard structures and signage structures. These structures are currently designed with dynamic wind effects neglected, although the National Structural Code of the Philippines (NSCP) code requires or to use a flexible-structure Gust Effect Factor (GEF), for structures with such aspect ratios. This flexible-structure GEF should be appropriate for the structure and compatible with the NSCP. This is a new requirement in the current NSCP that was not included in the previous NSCP and earlier versions use a rigid design. This study aims to propose structural analysis and design of latticed billboard structures and closed signage structures to be able to promote and encourage joint undertaking among the academe in the conduct of wind modeling researches and testing for the Philippines

Keywords: Advertisement, latticed billboards, signage structures, structural codes, structural engineering,

1. INTRODUCTION

An outdoor advertising sign in the form of a billboard consists of light a structural steel wide flange (WF) and angular members so interconnected with each other forming a series of triangles and quadrilaterals. They are either welded or bolted together to form the desired structure. Modern billboards conform to engineering standards and are constructed of steel, while older billboard structures are made of wood or angle iron frames. A billboard may be smaller than the permitted size. This allows for the addition of a cutout or extension within the square foot envelope of the permitted area.

Signage structures are normally single-post or double-post structures made either of closed or boxed structural steel sections.

Due to the very light material construction and competitive cost, structural steel WF and angular sections are the logical favorites of billboard structures and signage structure owners are those of reinforced concrete structures. Because of its higher costs and the requirement of different construction skills and equipment, aluminum sections are not common in billboard construction in the Philippines.

The Department of Public Works and Highways made an inventory of billboards damaged and affected by every year typhoon in the Philippines. Most of the tragic and well publicized billboard occurred in Metro Manila. The need for maintenance and design review may be considered by other sectors in the billboard industry as unimportant. By including these two points as vital in the consideration of the overall planning and implementation of billboard and other signage structure, the researcher will be able to address the objective of this manuscript.

Why did we conclude that maintenance and design review were considered unimportant by some sectors of the billboard industry? This conclusion came basically from members made by practising structural engineers, construction engineers, building officials, municipal/city engineers and the public in general. Billboards are "erect and forget" type of structures (ASEP, 2001). It is a common impression that billboard structures receive the mandatory primer and finish painting only before erection, and paint touch-up of welded joints after erection.

The repainting is not normally done on regular basis arrest corrosion that will cause the deterioration of the structure. Some billboards were “designed” by inexperienced structural engineers or in some instances by the structure fabricators themselves, based on previous experiences, and signed by civil engineers willing to risk their profession and integrity for a few thousand pesos.

The use of non-standard materials for billboard is rampant. This is also a serious problem that need to be addressed. It is common knowledge that some local steel manufacturers are still producing angular sections with lower strength, i.e., A-7 steel ($f_y=33000$ psi), and are being used by fabricators, with the obvious reasons of meeting deadlines and reducing the costs. The minimum specification shall be A-36 ($f_y=3600$ psi). A lot of undersized angles are also being used without the knowledge of the designer (ASEP, 2001). The use of common machine bolts instead of high strength bolts, e.g., A-325, A-449, A-490 is also a practise.

Moreover, the non-use of proper joint connections for billboard is also observed. The use of gusset plates, proper sizes and lengths of welds for joints is also a common practise. Sometime, no gusset plates are used at all. The use of single angles for long members, and the use of double angles, instead of wide flanged sections, for major vertical members may be indications of an inadequate design of structure.

Non-traditional construction practices are prevalent in the industry, like the use of acetylene torches in cutting sections or providing holes for erection bolts, instead of using the proper tools (Armijos, 2008).

In the Philippines, it is also a common observation that foundations are inadequate and were designed without the use of the correct soil bearing properties taken from the recommendation of a soils or foundation engineer through a site geotechnical investigation. This situation is made worse by the use of inadequate base plates, or the non-use of non-shrink grout, base plate and anchor bolts. Actual collapsed billboard structures were observed with pulled-out vertical members without any base plates or anchor bolts, sometimes with a lump of concrete that passed as concrete pedestals.

It is also common to hear comments from people in the industry that billboards and other signage structures can be designed using “reduced” wind loads, since it is a common practise to roll-up the tarpulin before a typhoon comes to relieve the structure of excessive stresses. Billboard structures must be designed using the National Structural Code of the Philippines.

This study aims to design billboard and signage structures that will not cause any adverse traffic hazard to motorists, cyclists and pedestrians and achieves a high level of quality in terms of its strength as barriers to natural disasters such as typhoons and earthquake. The design should be in accordance to the design of buildings and streetscape character of a particular locality.

2. LITERATURE REVIEW

The first known billboard was located in Thebes, an ancient Egyptian city, as long as 3,000 years ago. Billboard advertising was made popular with the invention of lithography, a type of printing that uses oil and water, in 1794. The Wall Drug company was the first company to institute a nationwide advertising campaign using billboards in 1931. Cigarette advertising on billboards became popular in the U.S. in 1971, when the Public Health Cigarette Smoking Act required tobacco companies to cease advertising their products on radio and television, prompting a number of these companies to move their advertising outdoors. However, advertising cigarettes on billboards became illegal in 1987 (Floyd, 2000).

2.1 BILLBOARDS

A billboard is a large outdoor advertising structure, typically found in high-traffic areas such as alongside busy roads. Billboards present large advertisements to passing pedestrians and drivers. Typically showing large, ostensibly witty slogans, and distinctive visuals, billboards are highly visible in the top designated market areas. Bulletins are the largest standard-size billboards. Located primarily on major highways, expressways or principal arterials, they command high-density consumer exposure (mostly to vehicular traffic). Bulletins afford greatest visibility due not only to their size, but because they allow creative “customizing” through extensions and

embellishments. Posters are the other common form of billboard advertising, located chiefly in commercial and industrial areas on primary and secondary arterial roads. Posters are a smaller format than bulletins and are viewed principally by residents and commuter traffic, with some pedestrian exposure.

1.1.1 ADVERTISING STYLE

Billboard advertisements are designed to catch a person's attention and create a memorable impression very quickly, leaving the reader thinking about the advertisement after they have driven past it. They have to be readable in a very short time because they are usually read while being passed at high speeds. Thus there are usually only a few words, in large print, and a humorous or arresting image in brilliant color. Some billboard designs spill outside the actual space given to them by the billboard, with parts of figures hanging off the billboard edges or jutting out of the billboard in three dimensions.

1.1.2 PAINTED BILLBOARDS

Almost all these billboards were painted in large studios. The image was projected on the series of paper panels that made up the billboard. Line drawings were done, then traced with a pounce wheel that created perforated lines. The patterns were then "pounced" onto the board with a chalk filled pounce bag, marking the outlines of the figures or objects. Using oil paints, artists would use large brushes to paint the image. Once the panels were installed using hydraulic cranes, artists would go up on the installed billboard and touch up the edges between panels. These large, painted billboards were especially popular in Los Angeles where historic firms such as Foster & Kleiser and Pacific Outdoor Advertising dominated the industry. Eventually, these painted billboards gave way to graphic reproduction, but hand-painted billboards are still in use in some areas where only a single board or two is required.

1.1.3 TRADITIONAL BILLBOARDS

Traditional billboards are often seen on major highways and smaller streets. They're usually constructed of wood and metal, upon which a printed sheet of paper or vinyl is glued shown in figure 1. These signs are large, ranging in size from 12 by 24 feet to 14 by 48 feet. These signs are usually only able to portray one piece of advertising for an extended period of time; these signs often feature lights so passers-by can view the image at night (WDCP, 2009).



Figure 1: Traditional Billboard

1.1.4 MOBILE BILLBOARDS

A mobile billboard is a device within the marketing practice of advertising on the side of a truck or trailer that is typically mobile shown in figure 2. Mobile billboards are a form of Out-Of-Home (OOH) Advertising. Radio, static billboards, and mall/airport advertising fall into the same category. Using a mobile billboard for advertising

is an advertising niche called mobile outdoor advertising. Most mobile billboards are dedicated, customized trucks with large, but narrow, bodies for posting the advertisements(WDCP, 2009).



Figure 2: A Mobile Billboard

The different types of mobile billboard advertising are:

- a) Ad vehicles are mobile billboard trucks. They are stationary billboards set on wheels and attached to a cab truck. Another variety is a billboard that is placed in the center of a flatbed instead of attaching wheels to it. Either variation can be considered a highly effective means of advertising as they can be driven down any road or parked near any major event. Mobile billboard trucks usually come in 2 sizes 10'X 22' or 8'X16'.
- b) Scrolling trucks are rolling billboards look like delivery van with ads on the back and either side of the truck. An advertiser has the option of using both sides and/or the back for ads. The ads are easily changed creating an incredibly effective means of advertising for companies who have a need to change their ad design frequently.
- c) Glass trucks are also the size of large delivery vans with windows on the sides and back of the truck. The inside is empty and just waiting for the advertiser to fill. This is the perfect choice for a 3-D ad or an ad that actually uses live people in the advertisement. Innovation and creativity come into play making this an incredibly artistic use of mobile advertising .
- d) Trailer banners are advertising billboards that traverse wide areas then advertising on the side of a cross-country semi-truck is a good option. These take the form of banners that stretch across the entire side of the truck or smaller panels that are put together and attached to the side of a semi trailer to make one large ad.
- e) Fleet Ads is one of the best means of advertising is a wrap ad on a fleet vehicle. This works generously for companies with quite a few vehicles on the road at the same time. By displaying the same ad on all company vehicles it is always seen and usually remembered.
- f) Mobile televisions are rolling billboards and actually trucks with huge screen TVs inside them. The advertiser can display a commercial or animated campaign within/on the vehicle. This choice is very effective at shows and events where the vehicle will be parked for periods of time to be viewed by pedestrians.
- g) Bicycle advertisements is one of the newest advertising billboards are bike ads. The bikes have a four-wheel frame. The rider sits close to the ground maneuvering the bicycle. The ad, in an A-frame, is placed on the back of the bicycle between the two back wheels. The advantage here, is the ease with which the bicycle can maneuver through traffic or move through areas that motor vehicles are not allowed. In addition bicycles move slower than vehicles so the ads can be ready a bit easier. This is clearly a more eco-friendly option of mobile advertising thereby useful in appealing to a “green” population.

1.1.5 DIGITAL BILLBOARDS

A digital billboard is a billboard that is created from computer programs and software (WDCP, 2009). Digital billboards can be designed to display running text, display several different displays from the same company, and even provide several companies a certain time slot during the day shown in figure 3.



Figure 3: Digital Billboard

1.1.6 INFLATABLE BILLBOARDS

Inflatable billboard is an inflatable framework with an attached banner ad. Most appear near sports events or exhibitions, but can be installed nearly everywhere shown in figure 4. They are secured with weights and ropes and ideal for advertising banners that need to be moved around to multiple locations, or to be sited into locations that are remote or difficult to get to. They are a cost effective way of quickly placing your adverts into most locations for both short and long term campaigns (WDCP, 2009).



Figure 4: Inflatable Billboard

2. LOCAL ENVIRONMENTAL PLAN & BUSINESS IDENTIFICATION SIGNAGE

The permissibility for the display of advertisements and the erection of advertising structures is subject to the provisions of the relevant LEP applying to the site (Ganiron , 2013). The relevant LEP also contains Exempt and Complying Development provisions. Exempt development is a form of self-assessed development which can take place without the need for Council approval. Business identification signage is classified as Exempt Development under the relevant LEP applying to the site where such signage complies with the requirements for the relevant type of signage. Where a proposed business identification sign does not comply with the specific Exempt

Development requirements for the particular type of sign, then the proposed sign will be subject to the lodgement of a formal Development Application with Council. Types of business identification signs are highlighted on figure 5.



Figure 5: Business Identification signs

3. STRUCTURAL ANALYSIS AND DESIGN OF LATTICED BILLBOARD STRUCTURES AND CLOSED SIGNAGE STRUCTURES

In the Philippines, the “age” of some of billboard structures and signage structures that have been built many years ago can safety be assumed that structural analysis and design of these billboards structures and signage structures were done using the 2001 National Structural Code of the Philippines (NSCP) code. From the way, they were constructed lacking in gusset plates and of “too many” unnecessary structural members, it could said that some of the billboard structures were not designed at all, or worse, were just copied from a design of a similar structure intended from a different location but “ adopted” in a “different” circumstance. The billboard owners resorted to this deplorable practice scrimp on the structural design fee but exposing the billboard advertisers to “bad publicity” and the general public to a clear and present danger (Gavieta, 1997).

Separate billboard structures and signage structures with respective individual foundations anchored to the ground is a good practice because the structures can be fully designed and constructed with a full potential of better performance when subjected to design wind speeds. Furthermore, as compared to structures built on separate foundation anchored on the ground pose less and controllable hazards to people especially if there are no occupants below or within them.

Billboard structures and signage structures designed and built on top of the existing (old or relatively new) buildings pose an immediate hazard to the building/structure occupants. The practice of putting new billboard structures and signage structures on top of old existing buildings with “age” disparity between them of more than five (5) years old is not recommended because, in more ways than one, the “old” existing buildings were designed using an “older” code or do not have any provisions for billboard and signage structures in the future.

The practice of designing and constructing new billboard structures and/or new signage structures built on top of new buildings is acceptable especially if the billboard structures and/or the signage structures together with the new building structure are designed at the same time and the billboard structure and/or signage structure constructed immediately after the new building structure has been topped off.

The current practice of reducing the design wind speed by 23 kph from the code wind speed requirement indicated in the NSCP Vol. 1. Wind Map for a particular wind zone because the billboard tarpaulins are either rolled up or down before the arrival of the typhoon or would “break-up” or “tear-up” before the design wind speed velocity of 200 kph is attained as exposed by the billboard owners and contractors. Yet, the damage statistics showed especially during the typhoon that the billboard structures collapsed just the same even if the tarpaulins were already rolled up or rolled down. This is due to the numerous lines of lattice frames between the front frame and the rear frame of the “poorly” designed or “poorly” constructed billboard structures. Rounded structural elements (like pipes and square tubes) and lesser number of intermediate frames between the front frame and the rear frame billboard structures would reduce wind flutter thus reducing wind drags or forces on the billboard structures. From the statistics, failure of rounded single-post or double-post signage structures were not a numerous compared to latticed billboard structures. Put in a different way, a streamlined shape offers lesser obstruction from the structural steel members leading to smaller wind forces resulting to lesser construction costs of the billboard structure and signage structures (Schooler,1996). .

Forces coefficients of solid signs and for open signs and lattice frameworks are stipulated in tables 207-8 and 207-9 of NSCP Vol. 1 respectively. Signs with openings comprising less than 30% of the gross area shall be considered as solid signs. Signs with openings comprising less than 30% of the gross area shall be considered as solid signs. Signs for which the distance from the ground to the bottom edge is less than 0.25 times the vertical dimension shall be considered at ground level. Signs with the openings comprising 30% or more of the gross area shall be considered as open signs. Because of the too many lines of frames between the front frame and the rear frame of billboard structures, notwithstanding the claim that tarpaulin coverings are rolled or rolled down before the arrival of the typhoons, billboard structures should be analyzed and designed as solid signs.

NSCP Vol 1 recognizes that rational model tests are allowed to justify the use of smaller design wind speed for a particular structure at a specific location as they are affected by the surrounding buildings, structures and environment. Another question, however, would begin to crop up: what happens if the surrounding buildings or structures are changed or has disappeared in the future?

The design wind speeds stipulated in the latest NSCP Vol.1 Wind Maps should be used in the design and construction of billboard structures and signage structures. Compliance to the wind speed requirements in the latest NSCP Vol. 1 means an automatic compliance to the National Building Code of the Philippines in as much as the NSCP Vol. 1 is a referred code of the National Building Code of the Philippines.

Number of the members and joints in a billboard structure are numerous compared to a building structure of equivalent height such that structural analysis ends up analyzed in a very much simplified manner because the number of joints and members of a moderate height billboard structures could easily exceed 30000 which is the limitation of a computer based structural analysis software.

Incomplete stress paths from the wind face frame to the foundation support of poorly-designed billboard structures are evident especially in difficult or challenging sites.

4. DETAILING REQUIREMENTS FOR BILLBOARDS

Diagrams, illustrations or photographs and text may appear on the same page or as close as possible to their reference in the text. Illustrations or photographs should be placed on the page with captions directly beneath the illustration in 11-point font as demonstrated with Figure 1. The illustrations should reproduce well in black and white. No other colors will be used in the printing of the Proceedings. (Remember that you need to submit your camera-ready artwork at 600dpi). Caption appears numbered after the figure.

As the billboard structures are currently built, presumably designed by inexperienced and possibly “lowly paid” structural engineer, gusset plates are seldom used. Because either of the poor structural analysis or of the absence of any structural analysis or by using the “supposed” survival statistics of old billboards or due to the ignorance of the code requirements or when the billboard contractor scrimps on the construction cost and also to be shorten the construction time, gusset plates are normally used or discarded(even if shown in the drawings). Due to the very

low fees paid to them, these inexperienced structural engineers do not have the incentive to perform the complete analysis and design and to fully show all the relevant yet necessary construction details that would enable the structure to resist design forces. One could say that you get a service commensurate to the amount of money you paid one to render that particular service.

To ensure the full utilization of the billboard and signage structural steel sections, the following dimensions and detailing requirements are recommended: (a) Usage of A7 steels, which are still found locally should be stopped. (b) Minimum gusset plate thickness should be 12.7 mm when connecting the various lattice members meeting at a joint. (c) If used, structural steel pipe section shall be a minimum PS3. (c) If used, structural steel pipe tube shall be a minimum LS 75 x 75 x 30. (d) If bolted construction is used, minimum structural steel angular section shall be 2-65 mm x 50 mm x 5 mm thick A-36 steel connected with the use of minimum 2-20 mm diameter high strength bolts into the gusset plate with an edge distance of 75 mm between the bolt centerline to the gusset plate edge. (e) If welded construction is used, minimum structural steel angular sections shall be 2-50 mm x 50 mm x 3 mm thick A-36 steel connected with the use of a fillet weld of 13mm minimum thickness into the gusset plate.

Figure 6 shows the billboard structure with adequate gusset plate at the structural member intersections located in Metro Manila which survived typhoons.

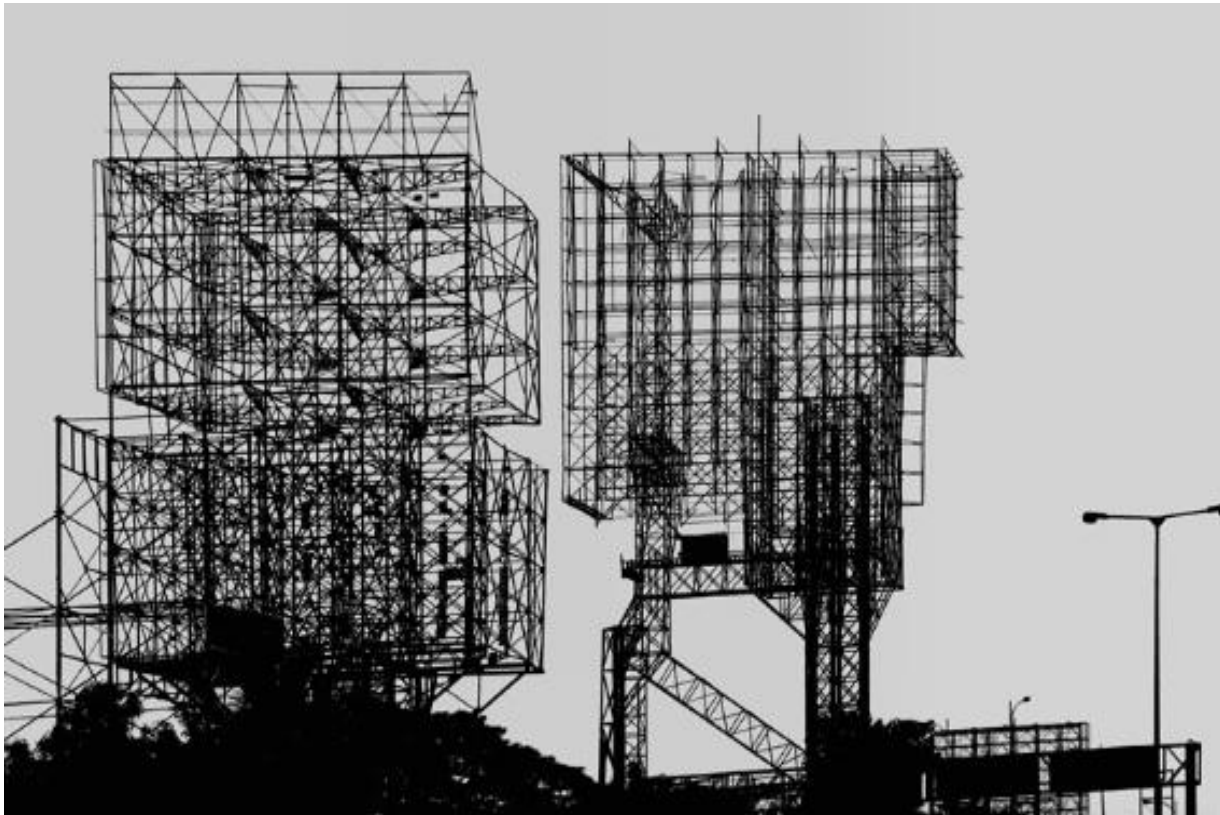


Figure 6: Billboard Structure (with gusset plate)

Figure 7 shows a billboard structure built in Metro Manila without adequate gusset plates at the structural member intersections and did not survived in typhoons.



Figure 7: Billboard Structure (inadequate gusset plate)

5. CONSTRUCTION TECHNIQUES IN BILLBOARDS

“Pierce-by-pierce” construction with the use of Gin-pole techniques is very common and popular in the billboard structure construction. Sometimes, mobile cranes are used in the construction of billboard structures in “open” areas. As they are built, base plans of billboard structures vary from square, rectangular, triangular or trapezoidal. Current billboard structure and signage structure heights now reach up to 100 m. Current billboard widths could be as wide as 40 m.

Poor interconnection between the new structural steel or even reinforced concrete pedestal of the billboard and signage structures onto existing roof trusses of old and sometimes very weak buildings are common.

Welding works during construction on these billboard/signage structures pose sparks and fire hazards to the general populace and pedestrian that could be passing below these structures. Welding needs a good supply of electrical power that should be supplied by an electric generator, if stable electric supply is not available in the project site.

Bolted construction would need thicker and wider structural steel angular sections and gusset plates. Involvement of low-paid structural engineering during fabrication and construction phase of billboard and signage structures are very seldom. Simple trade’s people or low paid civil engineers hired by the billboard owner’s normally don’t have the required expertise

6. CONCLUSIONS AND RECOMMENDATIONS

In these trying times, most billboards operators in the Philippines feel that the future of the industry has become bleak This is just the growing pains of the industry which shall soon establish itself as force in advertising media. Philippine Congress deliberates on various drafted house bills in relation to billboards. Through some issues

involve zoning, content and even in the environment, the question of size limitation is a substantial concern which the industry must resolve.

In the course of these Congress hearings, the following principles should be given emphasis. (a) Every roadway in the country is unique. The limitation of size reduces the effectivity of the medium. The sizes should be dependent on the geographical and architectural landscape of each city or region. (b) In formulating, amending and implementing legislation on billboard sizes, the sectors which are directly affected should be involved in the deliberation, billboard operators, advertising agencies, government units, property owners and the advertisers themselves. (c) The expertise of engineers and architects should be given proper due. They should be empowered in exploring their technical creativity in which size is not a controlling factor.

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