

# Compliance of Standard Signages Provision based on Visual Inspection at Primary School Zones in Johor

Mohd Erwan Sanik<sup>1\*</sup>, Hazirah Bujang<sup>1</sup>, Nor Baizura Hamid<sup>1</sup>, Nur'Ain Idris<sup>1</sup>

<sup>1</sup> *Spatial Technology for Civil Engineering (STforCE), Centre for Diploma Studies  
University Tun Hussein Onn Malaysia, Pagoh Education Hub, 84600, Johor, MALAYSIA*

\*Corresponding Author: [erwans@uthm.edu.my](mailto:erwans@uthm.edu.my)

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## Abstract

This study investigates the compliance of road signage with standard safety provisions in primary school zones across Johor, Malaysia. With school zones being a focal point for child pedestrian safety, the presence of adequate signage is crucial to minimizing accidents and promoting compliance with traffic laws. Using a road safety audit approach, including both on-foot and drive-through inspections, data were collected from ten schools located near major roads. The study followed the MeTRA guideline to assess the availability and condition of road signage. Results showed a concerning 50% compliance rate, with only one school meeting all signage requirements. The findings reveal recurring issues such as missing signs, inadequate road infrastructure, and poor pedestrian facilities, posing significant risks to schoolchildren. The study concludes that both improving the physical road environment and educating students on safe road practices are essential steps towards enhancing road safety in school zones.

## 1. Introduction

A total number of 2,243 child pedestrian casualties were reported accounting for 27.9% of all pedestrian casualties from 2009 to 2012 (Nur Shaeza et al., 2018). Of these, the presence of child pedestrians' focal points is the school zone. According to Raha et al. (2019), most road users fail to obey the 30 km/hr speed limit at school zones along Federal Route 50 (Batu Pahat – Kluang Road), and the factor affecting this is aggressive driving and signage not meeting the required standards. As for the Civil Engineer's role in this matter, the road environment should be placed as the primary concern during the design and construction stages to cater the road safety issues. This includes road signages and roadside elements. The road safety elements such as a proper number of signages should be properly adhered to cater to the road user's compliance issue, especially at the school zone. According to Corine et al. (2017), reminders are a simple technique that could improve adherence. Therefore, enough signages that acts as reminders are essential on all main roads in the school zone. New roads usually comply with this since the Road Safety Audit has been mandatory for the new road project starting in 1997 (Abu Mansor et al., 2019). However, signages and roadside safety and maintenance issues along old roads must be justified with continuous inspection for compliance purposes.

The compliance of standard signages in primary school zones is crucial for ensuring road safety, particularly for vulnerable groups like children. Traffic signage plays a pivotal role in maintaining safety, especially where students frequently walk or cycle to school. According to Federica & Isabella (2018), children tend to focus on elements that do not necessarily contribute to safe crossing behaviors, underlining the importance of clear and effective signage. Similarly, the role of signage is emphasized in studies that demonstrate how road features, including speed limit signs, impact driving behavior (Yao et al., 2020). The effectiveness of traffic signs in

reducing accidents and improving road safety is well-documented. A study by Manuela et al. (2021) revealed that a 30 km/h speed limit sign in school zones reduced near-miss incidents between vehicles and pedestrians by a factor of seven. However, Preeti et al. (2021) noted that students often express concerns about inadequate traffic signs, which could compromise their safety. To address such concerns, improvements in road mapping systems and enhanced traffic signage are recommended to ensure clarity and reduce risks (Dieudonné et al., 2021).

Although signage is critical, the presence of other infrastructure also plays a role. Rizati et al. (2020) stress the importance of pedestrian crossings, especially in primary school zones, to mitigate the dangers posed by risky motorist behavior. Additionally, proper footpath provisions are essential in reducing conflicts between pedestrians and motorcyclists (Suhaila, 2019). Despite these measures, the comprehension and effectiveness of signage among younger students remain challenges. Aleksandar et al. (2017) found that children struggle more than adults in understanding road signs. This gap between recognizing and fully understanding traffic signs highlights the need for both education and the design of child-friendly signage (Maxwell et al., 2020). Further research also suggests integrating additional safety features with standard signages. For instance, auditory warning sounds could enhance the visibility and effectiveness of traffic signs in school zones (Min-Wook & Salah, 2018). Moreover, Dario et al. (2020) recommend that speed limit signs should be accompanied by warning signs at critical points, such as sharp curves or high-risk areas, to reinforce road safety.

In terms of behavioral influence, students' perception of road safety is shaped by the presence and clarity of traffic signs. Bruce (2017) stresses the importance of maintaining safe road environments around primary schools, taking into account traffic volume and speed. For instance, Shahram & Juan (2020) noted that intersections near schools tend to attract many pedestrians, thus increasing the potential for road accidents. The overall compliance of standard signage provisions, including speed limits, pedestrian crossings, and other road safety measures, is essential to protecting students in school zones. This is especially critical when considering studies showing that many road users, including cyclists and motorcyclists, do not possess full licenses (Noradrenalina & Kamal, 2020). In summary, ensuring that proper signage is in place, understood by all road users, and accompanied by supportive infrastructure is fundamental to enhancing safety in primary school zones. Therefore, this study was carried out to identify compliance with standard signages along roads adjacent to schools and to highlight recurring safety issues. The findings may assist local authorities such as the Jabatan Kerja Raya (JKR) in ensuring the proper provision of road safety features at school zones in Johor.

## 2. Methodology

### 2.1 Structure

Files must be in MS Word only and should be formatted for direct printing, using the CRC MS Word provided. In this study, researchers have explored Google Maps application to locate schools that meet the selection criteria. The criteria are the location of the school that must be adjacent to the major road and preferably a government school since it was designed and built with the standard requirement by approval authorities from the beginning. The list of schools was then visited by researchers and then finalized so proper planning for data collection could be produced. Data was collected as soon as the list of study locations was finalized. Table 1 lists the ten primary schools in Johor that were inspected in this study to assess the compliance of road signage with standard requirements in school zones.

**Table 1** List of inspected primary schools

No.	Name of School	Code
1	Sekolah Kebangsaan Bandar Pontian	SK01
2	Sekolah Kebangsaan Kota Dalam	SK02
3	Sekolah Kebangsaan Kota Raja	SK03
4	Sekolah Kebangsaan Nong Chik	SK04
5	Sekolah Kebangsaan Panchor	SK05
6	Sekolah Kebangsaan Peserai	SK06
7	Sekolah Kebangsaan Parit Bilal	SK07
8	Sekolah Kebangsaan Puteri Ledang	SK08
9	Sekolah Kebangsaan Sri Tangkak	SK09
10	Sekolah Kebangsaan Senggarang	SK10

### 2.2 Road safety inspection

Data was collected using the road safety audit approach, which is either a drive-through or on-foot examination. A study by Kristina et al. (2021) emphasizes the importance of road safety audits for road networks. Methods from road safety audits were also used in this study. The inspection was based on the MeTRA guideline checklist at the school zone. MeTRA is a comprehensive compilation of the Road Safety Audit elements by the Malaysian Institute of Road Safety Research (MIROS, 2020)). Data was analysed and compiled in a database for a future compliance inspection. The result was the compliance rate of standard JKR signages at school zones. A conclusion will be made based on the findings. Fig. 1 shows the school zone layout of signage placement according to the Arahan Teknik (Jalan) 12/87 used in MeTRA.

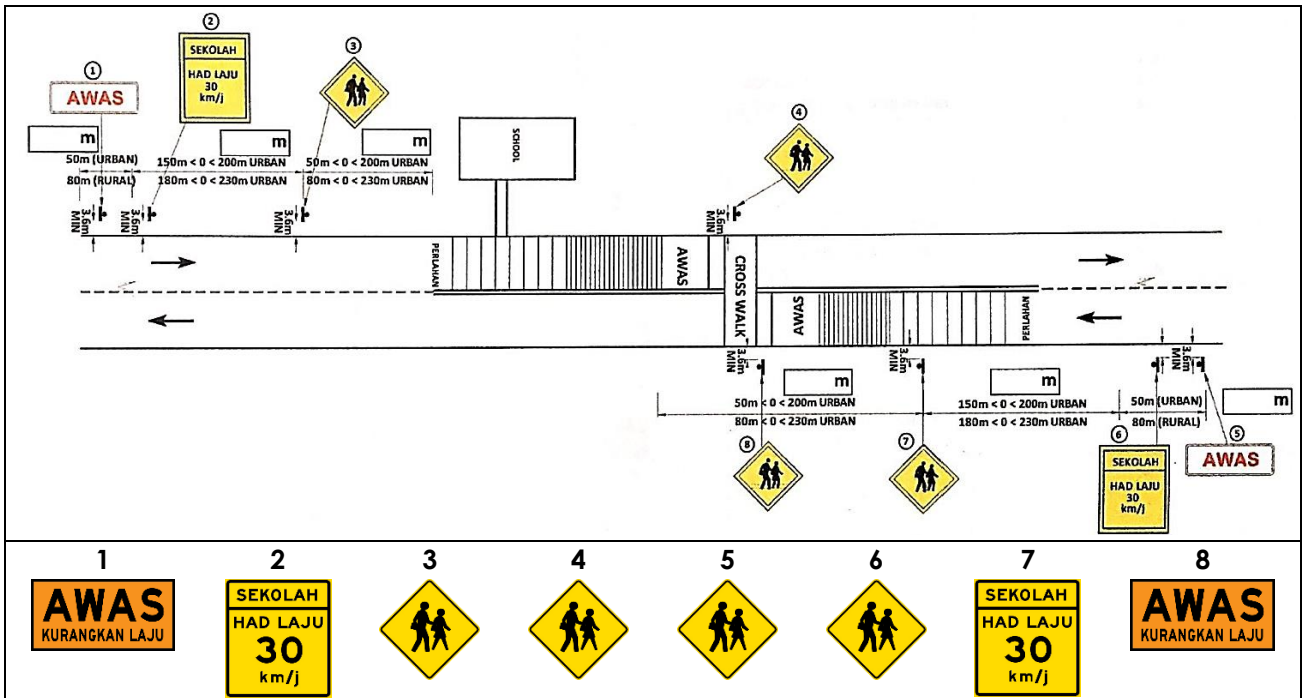


Fig. 1 School Zone Layout and List of Signages (1- 8)

The availability of eight signages in Fig. 1 was observed and recorded along with random inspections that concern safety issues such as the condition of the signages, pavement, sidewalk, provision of bus lay-by, and others. The reports at every school were analyzed, and recurring issues were identified using thematic analysis. This analysis requires the researcher to read through the reports to identify key themes (recurring problems, causes of issues) and to ensure a detailed narrative of the most common problems, possible root causes, and themes of recurrence.

### 2.3 Compliance and Chi-Square analysis

The data were then analyzed using Equation (1) to determine the compliance rate.

$$Compliance\ Rate = \frac{(Total - NonCompliance)}{Total} \times 100 \tag{1}$$

Based on the compliance observations, a Chi-Square test was conducted to determine if there was a significant difference in compliance between schools. For this Chi-Square test, the hypotheses are:

- Null Hypothesis ( $H_0$ ): There is no significant difference in the level of compliance with safety signs across the schools. In other words, the observed variations in compliance and non-compliance are due to random chances.
- Alternative Hypothesis ( $H_1$ ): There is a significant difference in the level of compliance with safety signs across the schools. The variations in compliance and non-compliance are not due to random chances.

The expected values are calculated based on the assumption that compliance and non-compliance are uniformly distributed across the schools. The formula for expected values ( $O$ ), for each cell, is as shown in Equation (2).

$$E = \frac{(row\ total \times column\ total)}{grand\ total} \tag{2}$$

The Chi-Square statistics ( $\chi^2$ ) are calculated by summing the squared differences between observed and expected values, divided by the expected values, for each cell, as shown in Equation (3).

$$\chi^2 = \sum \frac{(O - E)^2}{E} \quad (3)$$

### 3. Results

#### 3.1 Compliance and Chi-Square analysis

Table 2 presents the compliance observation of road signage in ten inspected primary school zones in Johor, highlighting the availability of eight signages, as can be seen in the school zone layout in Fig. 1. Table 2 reveals that only Sekolah Kebangsaan Peserai achieved full compliance, with 100% of the required signages in place. The remaining nine schools show varying levels of non-compliance, with Sekolah Kebangsaan Bandar Pontian and Sekolah Kebangsaan Nong Chik having the lowest compliance rate at 12.5%.

**Table 2** Observation outcomes and compliance analysis

School	Signage Availability								Total of Yes	Total of No	Compliance (%)
	1	2	3	4	5	6	7	8			
SK01	No	No	No	No	No	Yes	No	No	1	7	$[(8 - 7)/8] * 100 = 12.5$
SK02	No	Yes	Yes	No	No	Yes	Yes	No	4	4	$[(8 - 4)/8] * 100 = 50$
SK03	No	Yes	Yes	No	No	Yes	Yes	No	4	4	$[(8 - 4)/8] * 100 = 50$
SK04	No	No	Yes	No	No	No	No	No	1	7	$[(8 - 7)/8] * 100 = 12.5$
SK05	No	Yes	Yes	No	Yes	Yes	No	No	4	4	$[(8 - 4)/8] * 100 = 50$
SK06	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8	0	$[(8 - 0)/8] * 100 = 100$
SK07	Yes	No	Yes	No	Yes	Yes	Yes	No	5	3	$[(8 - 3)/8] * 100 = 62.5$
SK08	No	Yes	No	Yes	No	No	Yes	No	3	5	$[(8 - 5)/8] * 100 = 37.5$
SK09	Yes	Yes	No	Yes	Yes	Yes	Yes	No	6	2	$[(8 - 2)/8] * 100 = 75$
SK10	No	Yes	Yes	No	No	Yes	Yes	No	4	4	$[(8 - 4)/8] * 100 = 50$
Total											500
Average											500/10 = 50

Referring to Table 2, the overall compliance across all schools is 50%, indicating a significant shortfall in meeting standard signage requirements. This raises concerns about the safety of children in these zones, as missing or inadequate signage, such as speed limit warnings and pedestrian crossings, increases the risk of accidents. The results emphasize the need for improved road safety measures around schools to ensure adequate protection for young pedestrians. Table 3 shows the observed ( $O$ ) and expected ( $E$ ) values for compliance and non-compliance for each school.

**Table 3** Observed, Expected, and Chi-Square values

School code	Compliance (observed)	Non-compliance (observed)	Row total	Compliance (expected)	Non-compliance (expected)	Chi-Square (Compliance)	Chi-Square (Non-Compliance)
SK01	1	7	1+7=8			$(1 - 4)^2/4 = 2.25$	$(7 - 4)^2/4 = 2.25$
SK02	4	4	4+4=8			$(4 - 4)^2/4 = 0$	$(4 - 4)^2/4 = 0$
SK03	4	4	4+4=8			$(4 - 4)^2/4 = 0$	$(4 - 4)^2/4 = 0$
SK04	1	7	1+7=8			$(1 - 4)^2/4 = 2.25$	$(7 - 4)^2/4 = 2.25$
SK05	4	4	4+4=8	$(8 \times 40)/80 = 4$	$(8 \times 40)/80 = 4$	$(4 - 4)^2/4 = 0$	$(4 - 4)^2/4 = 0$
SK06	8	0	8+0=8	4	4	$(8 - 4)^2/4 = 4$	$(0 - 4)^2/4 = 4$
SK07	5	3	5+2=8			$(5 - 4)^2/4 = 0.25$	$(3 - 4)^2/4 = 0.25$
SK08	3	5	3+5=8			$(3 - 4)^2/4 = 0.25$	$(5 - 4)^2/4 = 0.25$
SK09	6	2	6+2=8			$(6 - 4)^2/4 = 1$	$(2 - 4)^2/4 = 1$
SK10	4	4	4+4=8			$(4 - 4)^2/4 = 0$	$(4 - 4)^2/4 = 0$
Total	40	40				10	10
Grand total		80				10 + 10 = 20	

Degree of freedom, <i>df</i>	(no. of row - 1) * (no. of column - 1) = <b>(10-1) * (2-1) = 9</b>
<i>p</i> -value (based on the Chi-square distribution table)	0.018

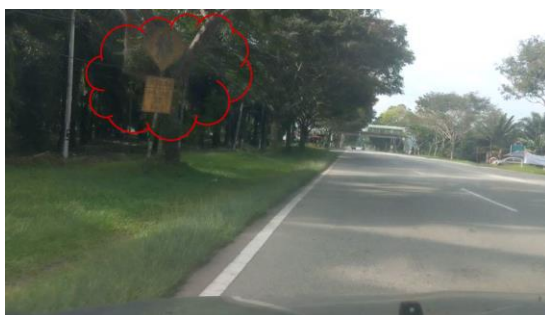
Referring to Table 3, the Chi-Square test results show an  $X^2$  statistic of 20, with a p-value of 0.018 and 9 degrees of freedom. Since the p-value is less than 0.05, this indicates that there is a statistically significant difference in compliance and non-compliance with the safety sign standards across the schools inspected. The null hypothesis (which assumes that there is no difference in compliance across schools) is rejected. The test provides evidence that there is a significant difference in the level of compliance with safety signs across the schools. The expected values for each category suggest that, in most schools, compliance and non-compliance were expected to be more balanced, with approximately 4 compliant schools and 4 non-compliant schools in each case. However, the observed values differ significantly from these expectations, highlighting that some schools either over-comply or under-comply with the required safety signs. A significant result suggests that interventions or improvements may be necessary in some schools to increase compliance with safety sign requirements. School authorities or policymakers may need to investigate the causes of non-compliance in specific schools to ensure safety standards are met.

### 3.2 Road safety inspection

Based on the road safety inspection carried out and the thematic analysis, the recurring issues identified across the 10 primary schools regarding road safety can be categorized as follows:

- i. Signage issues - missing or poor condition of signs
- ii. Road surface conditions - uneven and damaged road surfaces
- iii. Footpaths and pedestrian safety - damaged or inadequate footpaths
- iv. Lack of adequate road infrastructure - deceleration lanes and lay-bys
- v. Street lighting - insufficient or non-functional streetlights
- vi. Barriers and safety features - inadequate or poorly maintained barriers
- vii. Roadway markings - faded or missing road markings
- viii. Traffic flow and control - congestion and disruptions
- ix. Drainage and obstacles - uncovered drains and roadside obstacles
- x. Sign placement and visibility - visibility issues

Fig. 2 shows examples of the top four recurring safety issues. Common problems include inadequate or poorly maintained signage, such as missing AWAS, speed limit, or student crossing signs. Many schools, including SK01, SK02, and SK03, lacked proper signage, creating potential hazards. Issues with road conditions were noted, such as uneven pavement, potholes, and broken shoulders, which can cause accidents (e.g., SK03 and SK06). Additionally, the absence of essential infrastructure like deceleration lanes, pedestrian crossings, and street lighting were frequent concerns (e.g., SK02, SK04, and SK08). Many schools also faced issues with obstructed or damaged road markings and barriers, which compromise safety for both pedestrians and drivers (e.g., SK10 and SK06). Addressing these issues is critical to enhancing the overall road safety around school zones.



(a)



(b)



**Fig. 2** Examples of recurring safety issues; (a) poor sign at SK02; (b) uneven road surface at SK02; (c) damaged footpath at SK10; (d) no provision of bus lay-by at SK03

Standard signage in school zones is crucial for road safety as it significantly enhances driver awareness, promotes compliance with traffic regulations, and reduces speeding (Raha et al., 2019). By clearly marking school zones, speed limits, and pedestrian crossings, these signs alert drivers to their proximity to schools, encouraging them to drive more cautiously. Effective signage also improves pedestrian safety by guiding students and other pedestrians to designated crossing points, thereby reducing the risk of accidents (Szagała, et al., 2021). Furthermore, well-placed and standardized signs help manage traffic flow, prevent congestion, and ensure safe drop-off and pick-up procedures. They provide clear directions, reducing driver confusion and supporting safe navigation around school areas. Additionally, standardized signage aids law enforcement in enforcing traffic rules and encourages driver adherence to regulations (Szagała, et al., 2021). It also facilitates emergency response by helping services quickly locate and access school zones. Overall, standard signage is vital in creating a safer and more predictable driving environment around schools

#### 4. Conclusion

In conclusion, the study underscores the pressing need for enhanced road safety measures around school zones to protect young pedestrians. The inspection of ten primary schools revealed a concerning 50% compliance rate with standard signage requirements, highlighting significant gaps in the current road safety infrastructure. The Chi-square analysis provides evidence that there is a significant difference in the level of compliance with safety signs across the schools. Common issues included inadequate or deteriorating signage, poor road conditions, and insufficient pedestrian facilities. These deficiencies compromise the effectiveness of safety measures and increase the risk for schoolchildren. Addressing these issues is crucial, as effective signage and proper road infrastructure not only alert drivers to the presence of schools but also guide pedestrians safely across streets. Additionally, improving road safety around schools necessitates a dual approach: refining physical road conditions and signage while educating children on safe road practices. By implementing comprehensive improvements in infrastructure and education, a safer environment for students can be created, and the likelihood of accidents in school zones can be reduced. This study can be extended by considering the location of the schools being inspected. Therefore, researchers can identify whether the location, such as urban or rural areas, affects the level of compliance with the provision of safety signs. Additionally, the study can be expanded to secondary schools as there may be a higher risk of safety issues due to students riding motorcycles to school.

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#### Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Mohd Erwan Sanik; **data collection:** Mohd Erwan Sanik, Nor Baizura Hamid, Nur'Ain Idris; **analysis and interpretation of results:** Mohd Erwan Sanik, Nor Baizura Hamid, Nur'Ain Idris; **draft manuscript preparation:** Hazirah Bujang. All authors reviewed the results and approved the final version of the manuscript.

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