KAJIAN PENGGUNAAN ALAT PENANGKAP KILAT DI BANGUNAN-BANGUNAN DI MALAYSIA 2016

UNTUK
JABATAN KAWAL SELIA KESELAMATAN ELEKTRIK
SURUHANJAYA TENAGA MALAYSIA

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Mega Jati Consult Sdn Bhd

CONTENT

1) Introduction
   - Lightning Protection System (LPS)
   - Research Background
2) Research Objective
3) Research Finding
   - Research Objective 1 : Finding on Physical LPS (Scope 12.1 of TOR)
   - Research Objective 2: Finding on The Effectiveness of Installation of LPS
   - Research Objective 3: Finding on Compliance of Installation of LPS (Scope 12.2 of TOR)
   - Research Objective 4: Finding on the Installation of LPS Not According To Standard
   - Research Objective 5: Finding on Buildings With Early Streamer Emission (ESE) (Scope 12.3 and 12.4 of TOR)
   - Research Objective 6: (Findings on Compliance of Installation of Lightning Protection System and Its Components In Accordance With Relevant Standard (Scope 12.5 of TOR)
   - Research Objective 7: (Survey on Consumer's Understanding on The Importance of Lightning Protection System In Buildings (Scope 12.6 of TOR)
4) Result Analysis With Reference To Objective
5) Conclusion

INTRODUCTION

Lightning Protection System

Research Background

LIGHTNING PROTECTION SYSTEM (LPS)

Designed to protect a structure or building from damage caused by the high voltage or current due to lightning strike.

A lightning protection system offers a low resistance path to ground dispersing energy safely.

A typical lightning protection system includes:

1) Air Terminal

2) Down conductors

3) Ground electrodes

RESEARCH BACKGROUND

- The total number of buildings visited in this research is 419.

- Visited buildings is categorized into several categories.
  (Figure 1: Collected building numbers according to category as of 30th September 2016).

- Research sampling location is categorized into six (6) zones.
  (Figure 2: Actual research zones as of 30th September 2016).

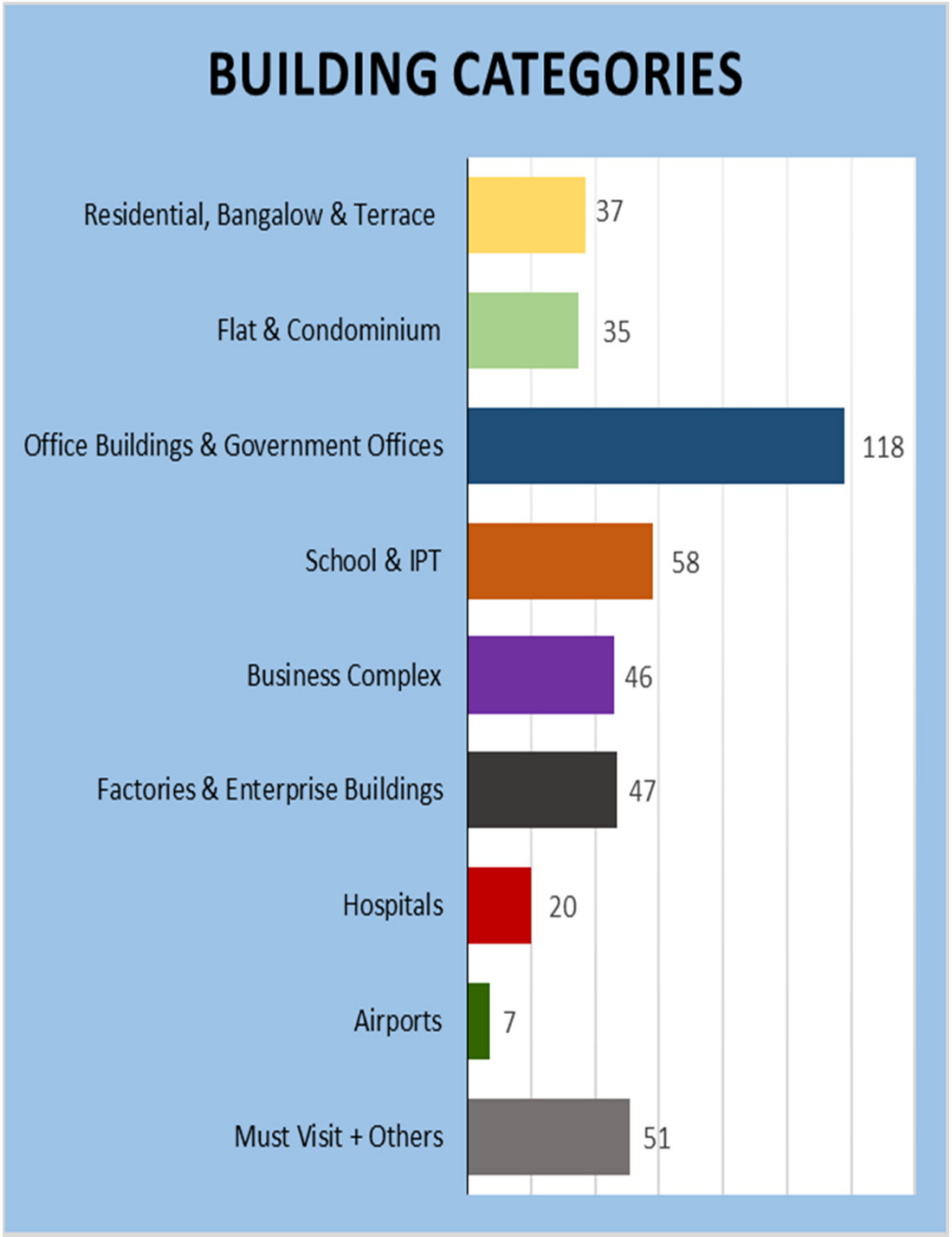


Figure 1: Collected building numbers according to category as of 30th September 2016

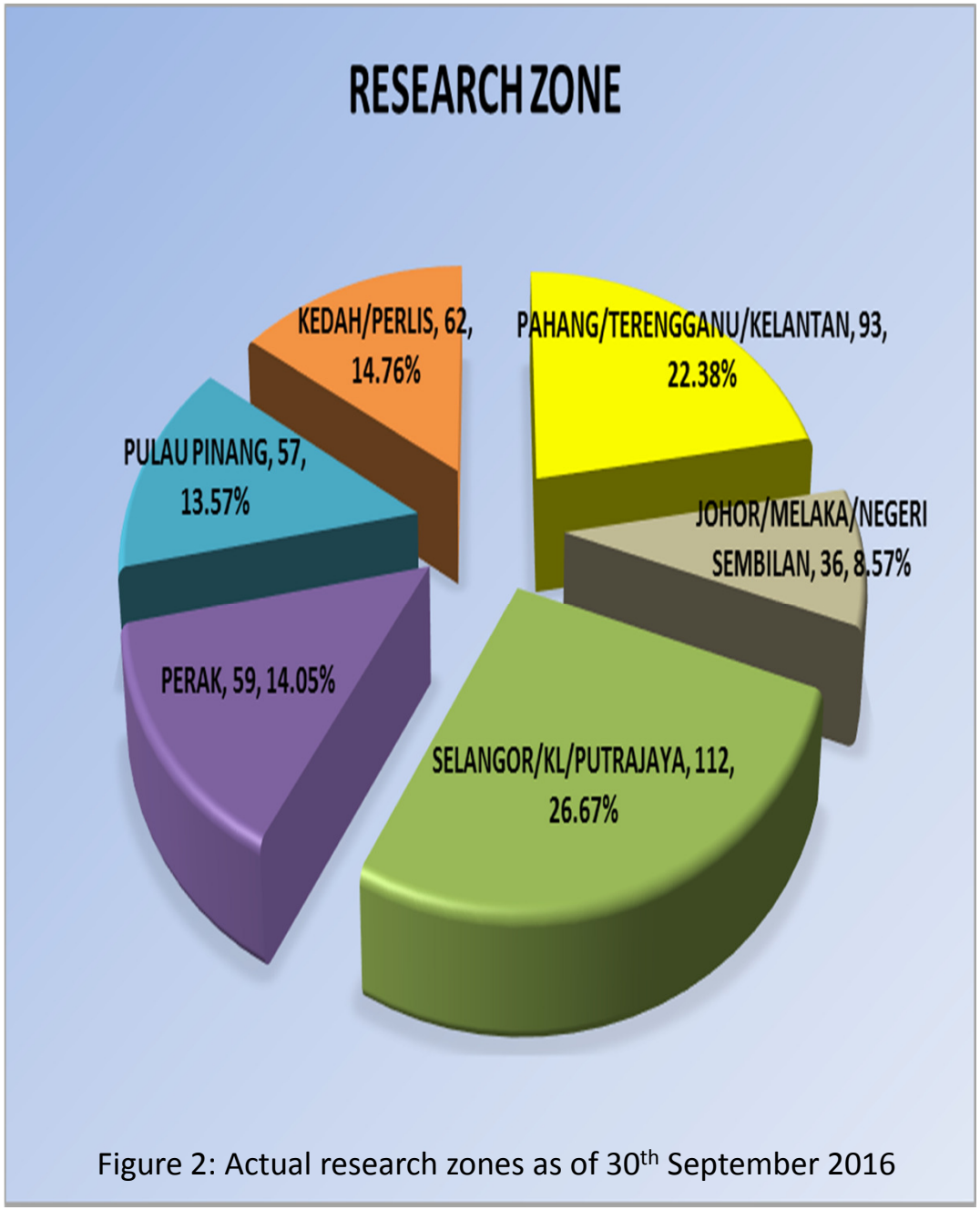
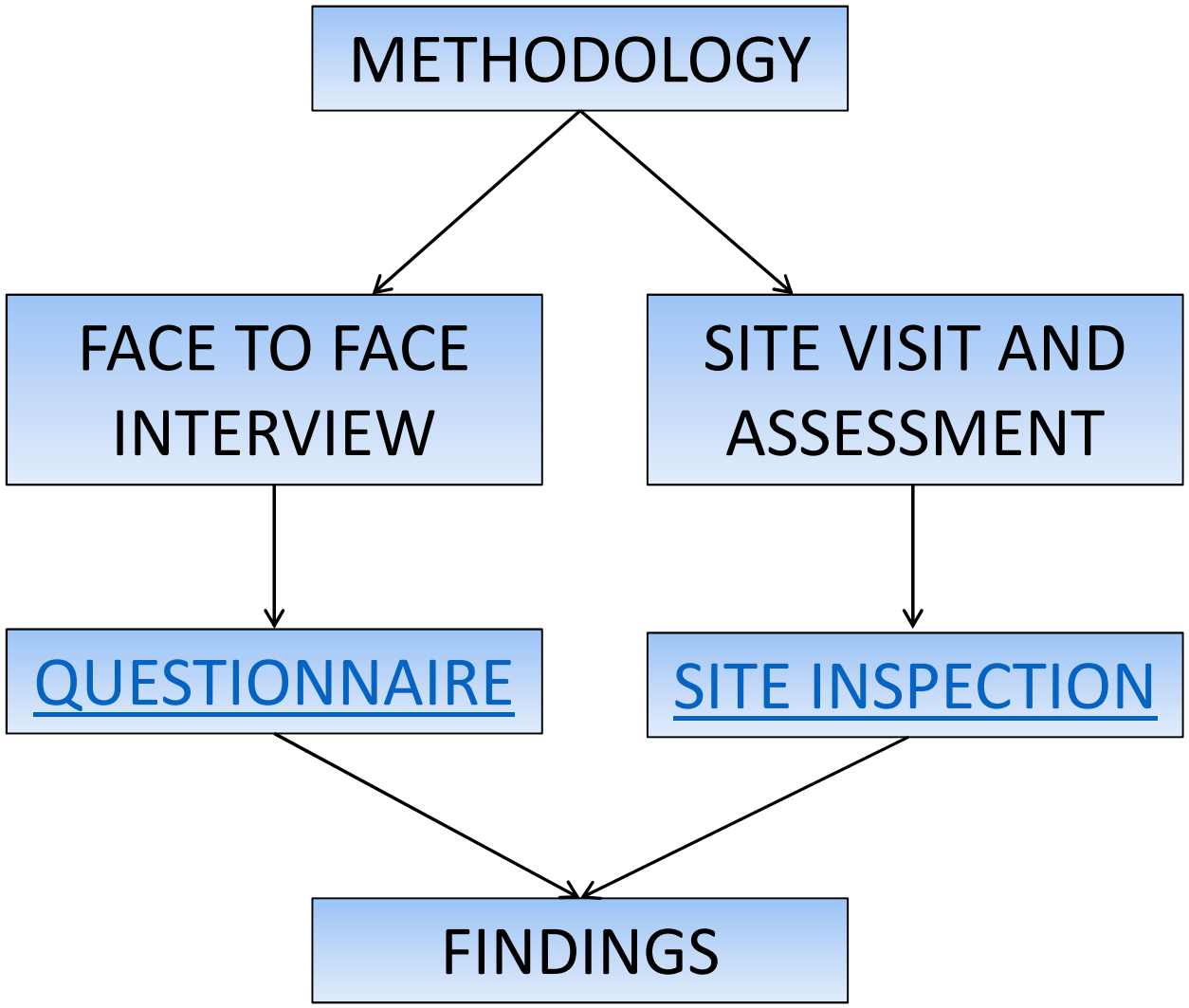
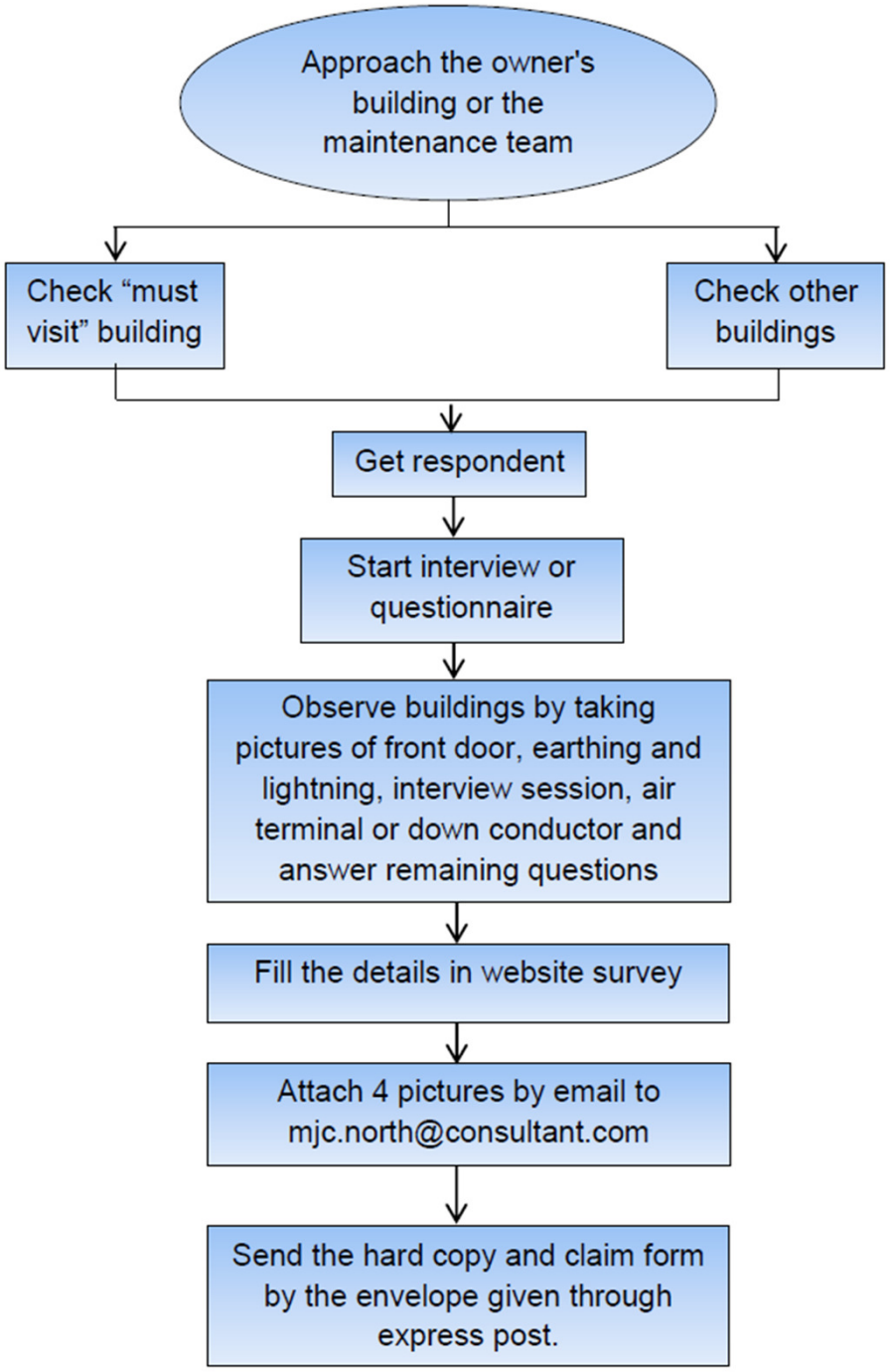


Figure 2: Actual research zones as of 30th September 2016


METHODOLOGY
FACE TO FACE INTERVIEW
SITE VISIT AND ASSESSMENT
QUESTIONNAIRE
SITE INSPECTION
FINDINGS

METHODOLOGY



RESEARCH OBJECTIVES

The objectives of these research as follows:

1) Objective 1 : Finding on Physical LPS (Scope 12.1 of TOR).

2) Objective 2: Finding on The Effectiveness of Installation of LPS.

3) Objective 3: Finding on Compliance of Installation of LPS (Scope 12.2 of TOR).

4) Objective 4: Finding on the Installation of LPS Not According To Standard.

5) Objective 5: Finding on Buildings With Early Streamer Emission (ESE) (Scope 12.3 and 12.4 of TOR).

6) Objective 6: (Findings on Compliance of Installation of Lightning Protection System and Its Components In Accordance With Relevant Standard (Scope 12.5 of TOR).

7) Objective 7: (Survey on Consumer's Understanding on The Importance of Lightning Protection System In Buildings (Scope 12.6 of TOR).

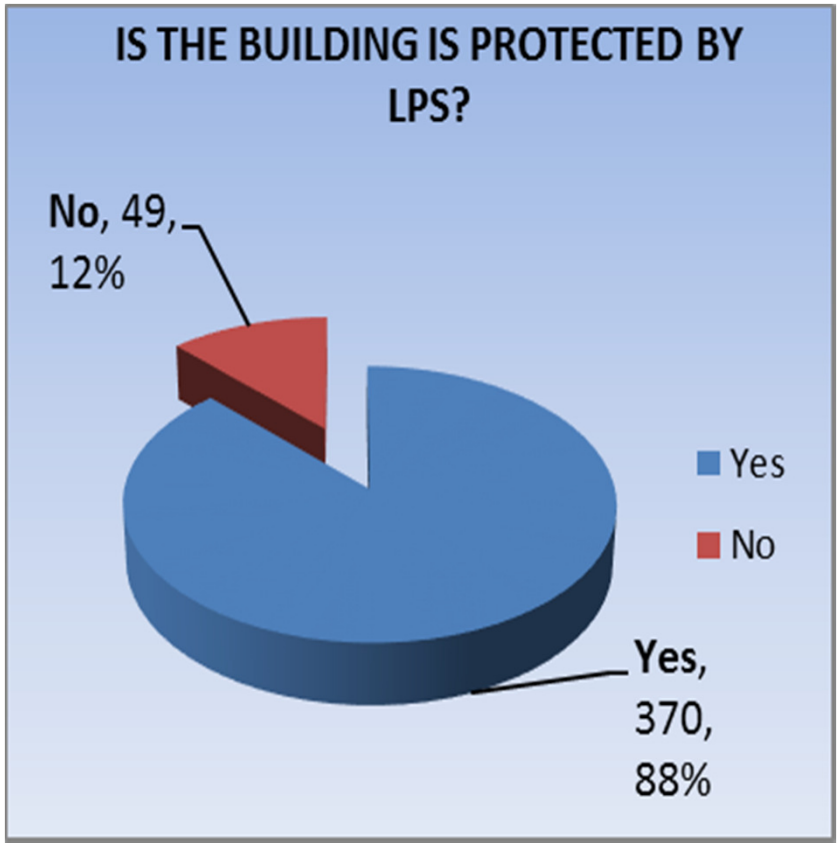
RESEARCH FINDING

Research Objective 1: Finding on Physical LPS

(Scope 12.1 of TOR)

To identify buildings with or without Lightning Protection System (LPS).

[Untuk mengenalpasti bangunan-bangunan yang dilengkapi dan tidak dilengkapi dengan alat penangkap kilat].



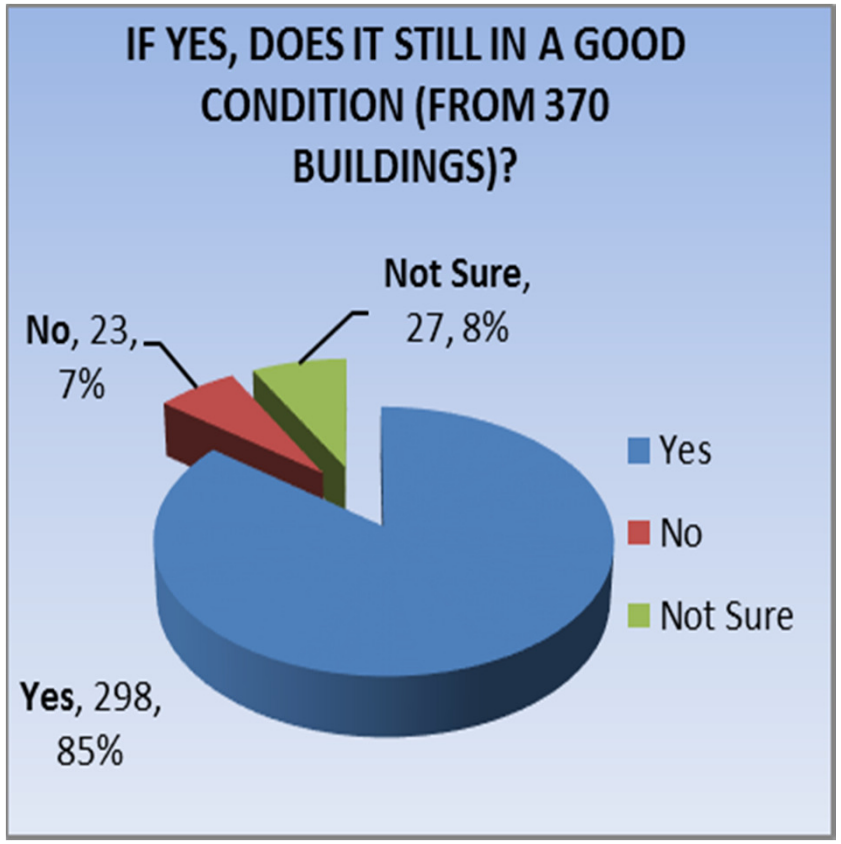


Figure 3: The LPS installation and the physical condition

Table 1 shows the distribution of building with and without LPS according to six (6) zones.

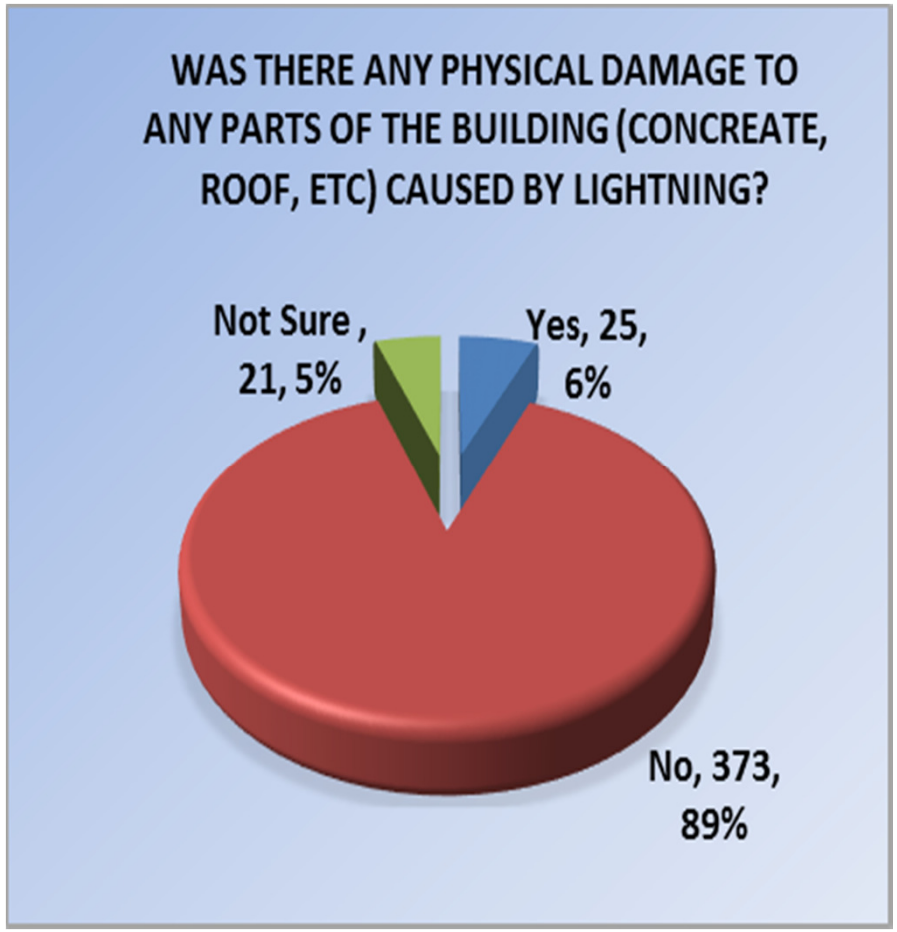
	TOTAL	Residential, Bungalow & Terrace	Flats and Condominiums	Government offices and office buildings	Schools & IPT	Business complexes	Industrial buildings & Factories	Hospitals	Airports	Must visit + Others
Building with Lightning Protection System (LPS)										
Selangor, Kuala Lumpur & Putrajaya	**109**	9	16	19	15	16	19	7	2	6
Kedah, Pulau Pinang & Perlis	**102**	3	8	45	15	12	3	2	1	13
Kelantan & Terengganu	**50**	1	0	14	11	5	4	3	2	10
Pahang	**30**	0	2	10	2	3	1	2	1	9
Perak	**50**	0	3	12	7	6	7	5	0	10
Johor, Melaka & Negeri Sembilan	**29**	2	4	5	3	4	6	1	1	3
TOTAL	**370**	**15**	**33**	**105**	**53**	**46**	**40**	**20**	**7**	**51**
Building without Lightning Protection System (LPS)										
Selangor, Kuala Lumpur and Putrajaya	**3**	0	0	1	1	0	1	0	0	0
Kedah, Pulau Pinang and Perlis	**16**	7	0	8	0	0	1	0	0	0
Kelantan and Terengganu	**7**	3	0	1	2	0	1	0	0	0
Pahang	**7**	5	1	0	1	0	0	0	0	0
Perak	**9**	4	0	2	0	0	3	0	0	0
Johor, Melaka & Negeri Sembilan	**7**	3	1	1	1	0	1	0	0	0
TOTAL	**49**	**22**	**2**	**13**	**5**	**0**	**7**	**0**	**0**	**0**

RESEARCH FINDING

Research Objective 2: Finding on The Effectiveness of Installation of LPS.

To identify the level of effectiveness of the installed LPS onto the buildings in providing the protection when lightning strike. Assessment must also be done on the physical damages to the buildings and all the electrical and electronic equipment installed in the buildings that incurred losses.

[Untuk mengenalpasti tahap keberkesanan sistem perlindungan kilat dalaman yang dipasang yang mencukupi bagi setiap bangunan dari panahan kilat yang boleh mendatangkan bencana kepada bangunan dan kemusnahan peralatan dalaman peralatan elektrik, komunikasi dan elektronik yang boleh menyebabkan kerugian yang besar].



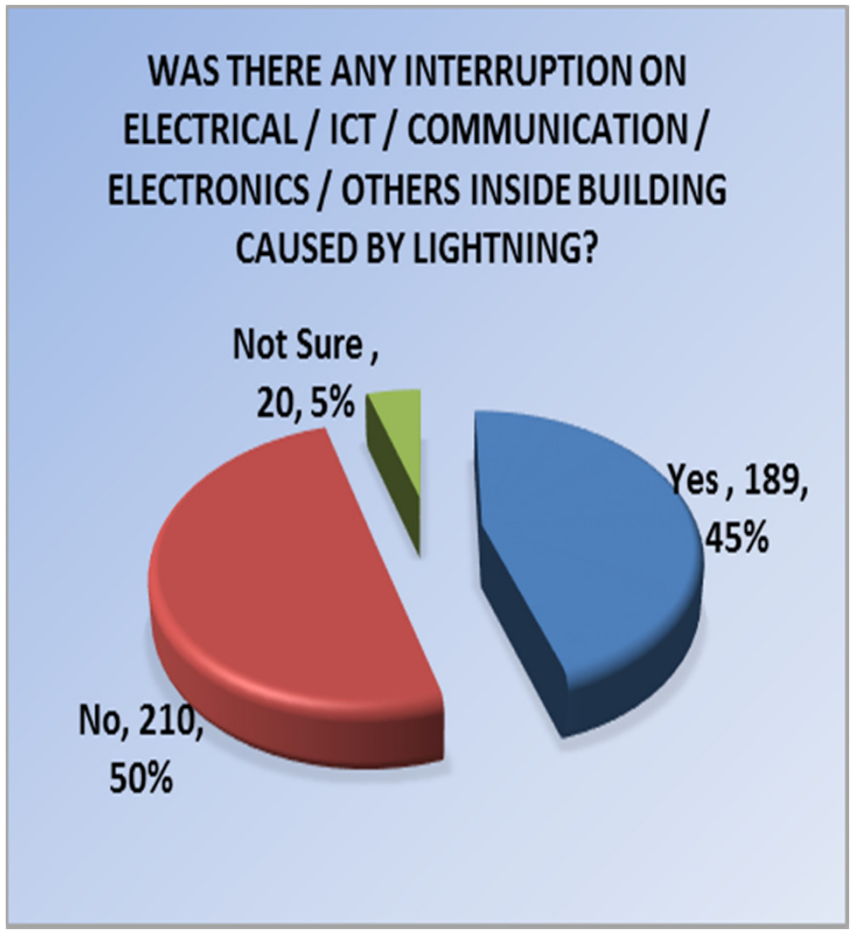


Figure 4: Physical damage and interruption due to lightning

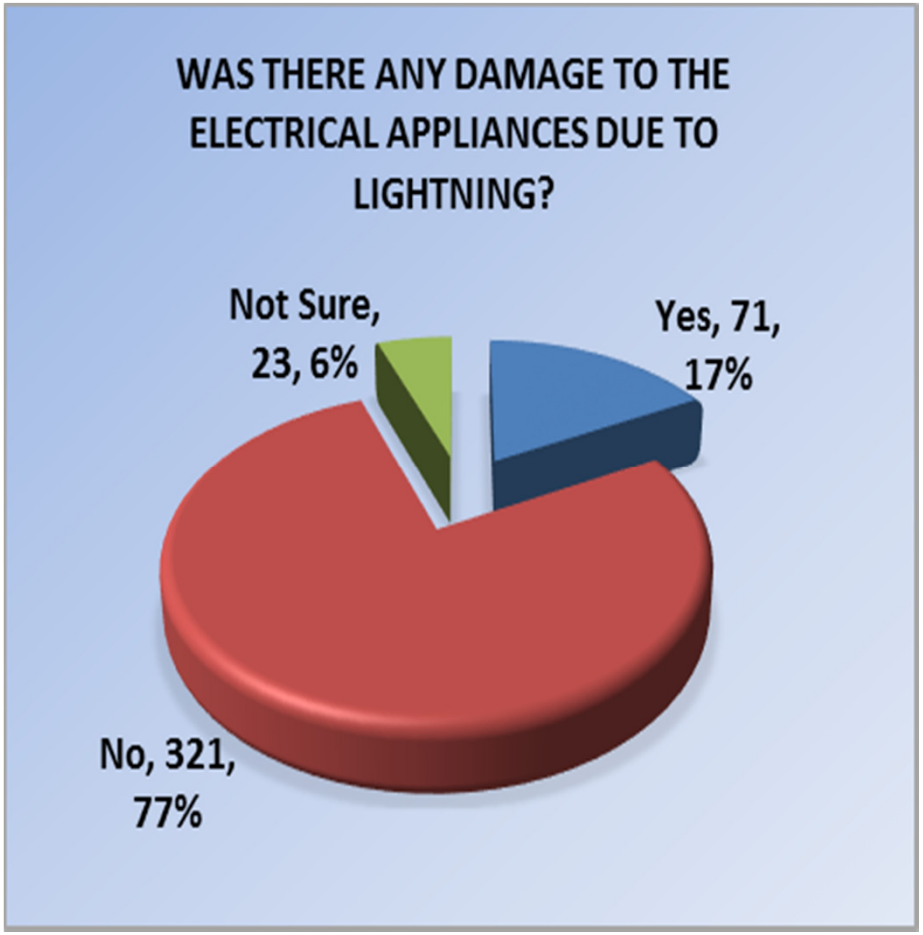


Figure 5: Damage to the electrical appliances due to lightning

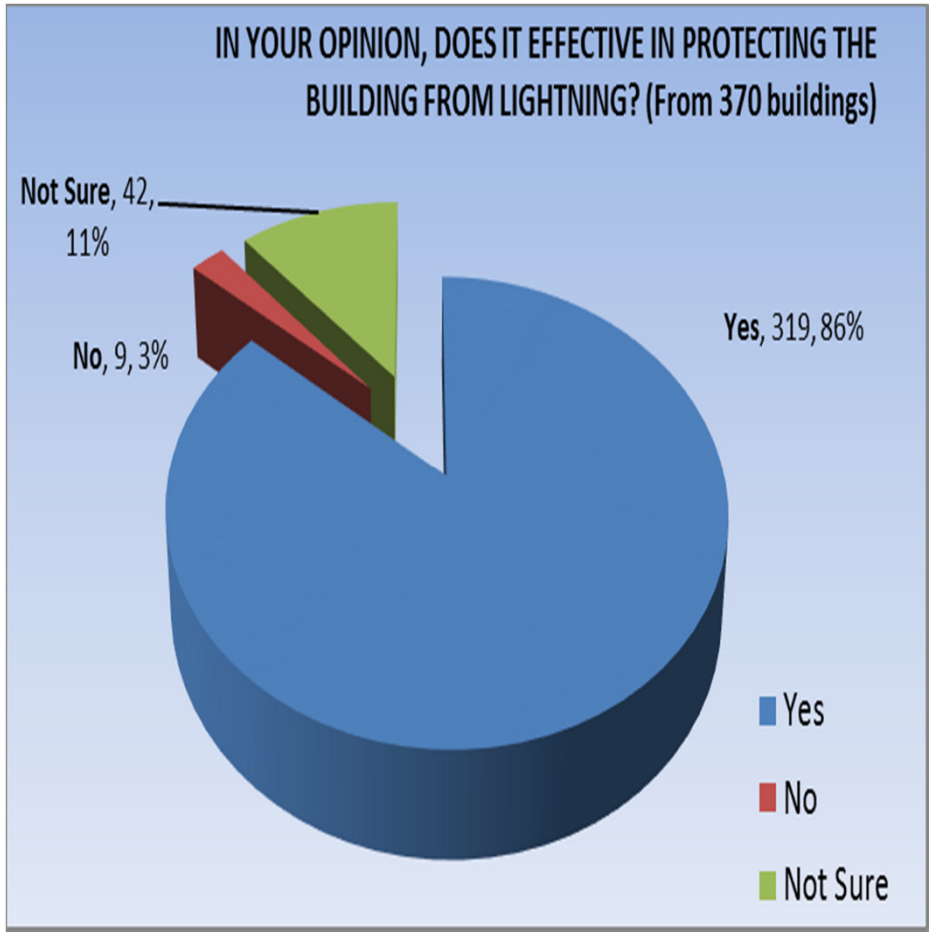


Figure 6: Effectiveness of LPS

RESEARCH FINDING

Research Objective 3: Finding on Compliance of Installation of LPS.

(Scope 12.2 of TOR)

To identify, high-rise and government buildings installed LPS in accordance to standard and regulations.

[Untuk mengenalpasti sama ada bangunan-bangunan tinggi menggunakan sistem perlindungan kilat yang betul dan mengikut standard dalam pemasangan alat perlindungan kilat termasuk bangunan-bangunan awam milik kerajaan].

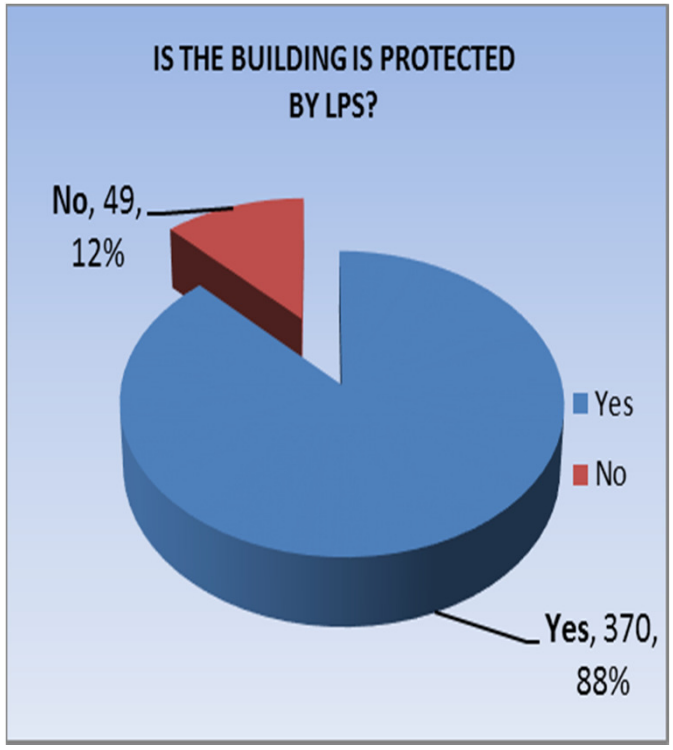


Figure 7: Building Installed by LPS

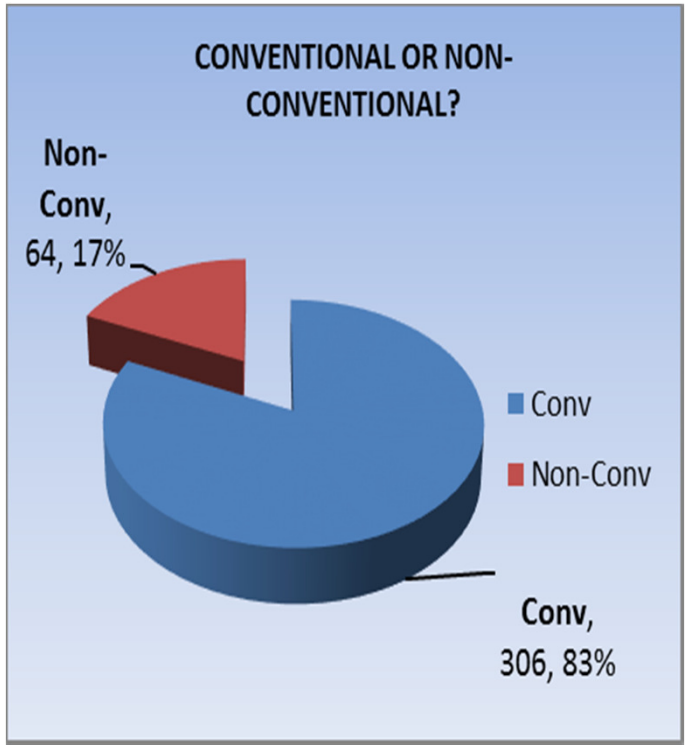
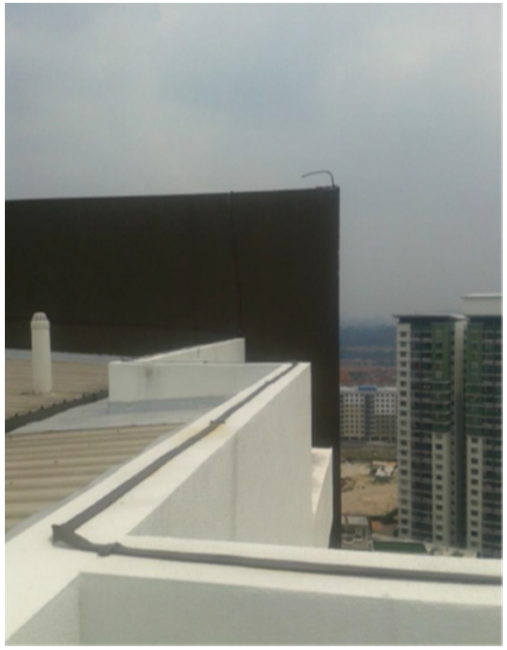


Figure 8: The type of Installation

CONVENTIONAL LPS

AIR TERMINAL

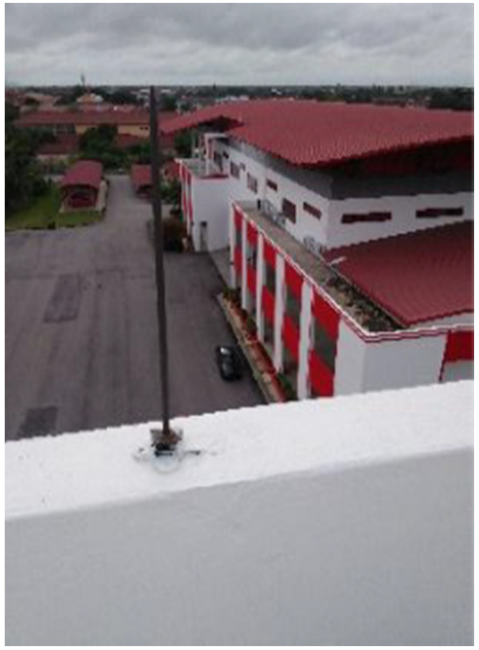


Building: Ameera Residence.

Air-terminal used is cooper tape. The cooper tape was lay on top of the perimeter of the building.

Building: Penang International Airport, Bayan Lepas.

Perimeter cooper mesh with franklin rod is used for LPS at this building.



Building: Balai Bomba Pulau Pinang.

The type of air terminal used at this building is Franklin Rod.

Building: Ericsson Shah Alam, Selangor.

The type of air terminal used at this building is franklin rod.

NON-CONVENTIONAL (EARLY STREAMER)

AIR TERMINAL

Building: Village Mall Sungai Petani, Kedah.

Early streamer emission (ESE) is use as air terminal for this building.

Building: Pengurusan Air Pahang Berhad.

Air terminal used at this building is early streamer.

Building: Kuantan Medical Centre (KMC).

Early Streamer Emission (ESE) is use as air terminal for this building.

Building: Wisma TNB, Jalan Yahya Awal, Johor Bahru.

Air terminal used at this building is early streamer.

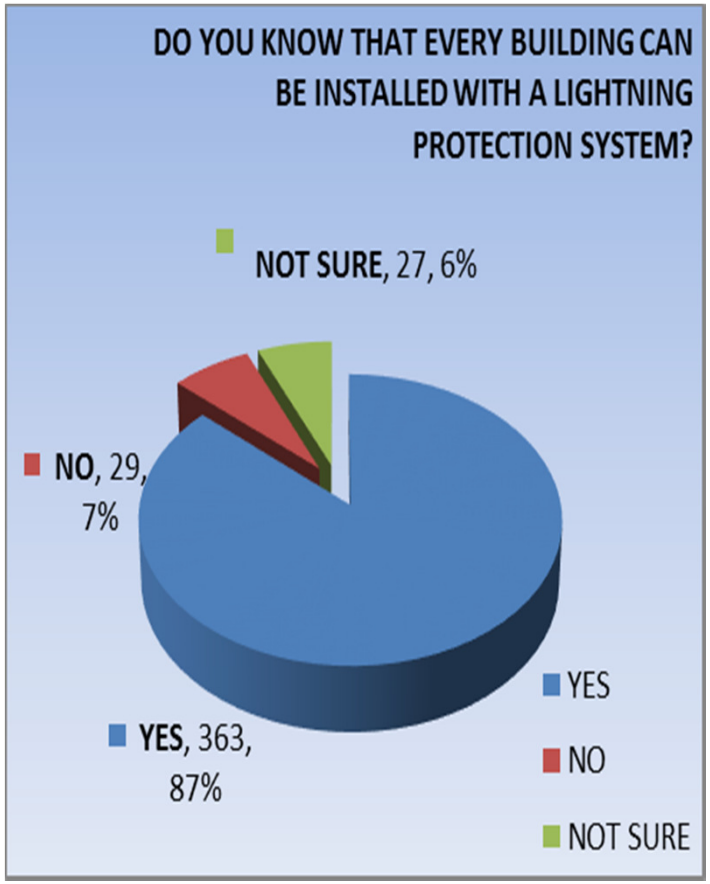


Figure 10: Public awareness on LPS

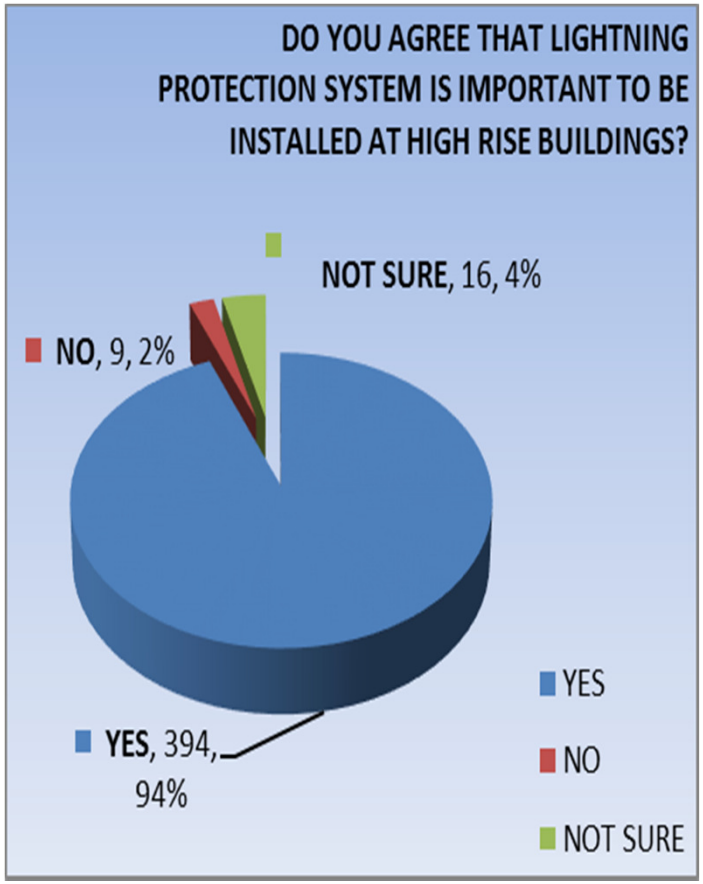


Figure 11: Public awareness on the importance of LPS at high rise buildings

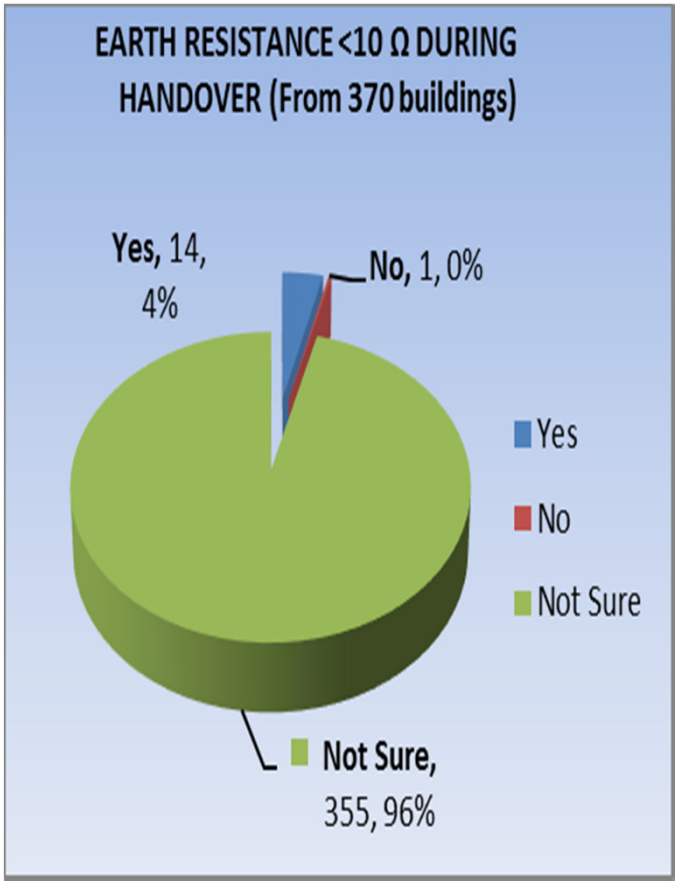


Figure 12: Earth resistance during handover

RESEARCH FINDING

Research Objective 4: Finding on the Installation of LPS Not According To Standard

To identify buildings that was installed with LPS not according to standard and its possibilities of not having effective protection when strike by lightning.

[Untuk mengenalpasti bangunan-bangunan yang menggunakan alat penangkap kilat yang tidak mengikut standard serta tidak berkesan dan tidak menjamin bangunan tersebut selamat daripada panahan kilat].

For comparison purposes, research objective 4 will be elaborated via comparison between building installed by conventional LPS method and non-conventional LPS method.

Table 2: Installation using conventional air terminal according to categories and damage identified on that building.

	TOTAL	Residential, Bungalow & Terrace	Flats and Condominiums	Government offices & office buildings	Schools & IPT	Business complexes	Industrial buildings & Factories	Hospitals	Airports	Must visit + Others
Using CONVENTIONAL LPS in installations										
Selangor, Kuala Lumpur and Putrajaya	**92**	8	15	15	13	14	17	6	1	3
Kedah, Pulau Pinang and Perlis	**82**	2	7	37	15	9	3	2	1	6
Kelantan and Terengganu	**46**	0	0	13	11	3	4	3	2	10
Pahang	**27**	0	2	10	2	3	1	2	1	6
Perak	**36**	0	3	12	6	2	6	4	0	3
Johor, Melaka & Negeri Sembilan	**23**	0	3	5	3	3	6	0	1	2
TOTAL	**306**	**10**	**30**	**92**	**50**	**34**	**37**	**17**	**6**	**30**
The damages identified on buildings with CONVENTIAL LPS installations										
Selangor, Kuala Lumpur and Putrajaya	**7**	1	2	0	2	0	0	1	1	0
Kedah, Pulau Pinang and Perlis	**8**	1	1	3	3	0	0	0	0	0
Kelantan and Terengganu	**1**	0	0	0	0	1	0	0	0	0
Pahang	**0**	0	0	0	0	0	0	0	0	0
Perak	**3**	0	0	1	0	0	0	1	0	1
Johor, Melaka & Negeri Sembilan	**3**	1	0	2	0	0	0	0	0	0
TOTAL	**22**	**3**	**3**	**6**	**5**	**1**	**0**	**2**	**1**	**1**

Table 3: Installation using non-conventional air terminal according to categories and damage identified on that building.

	TOTAL	Residential &Bungalow & Terrace	Flats and Condominiums	Government offices & office buildings	Schools & IPT	Business complexes	Industrial buildings & Factories	Hospitals	Airports	Must visit + Others
Using ESE in LPS installations										
Selangor, Kuala Lumpur and Putrajaya	17	1	1	4	2	2	2	1	1	3
Kedah, Pulau Pinang and Perlis	20	1	1	8	0	3	0	0	0	7
Kelantan and Terengganu	4	1	0	1	0	2	0	0	0	0
Pahang	3	0	0	0	0	0	0	0	0	3
Perak	14	0	0	0	1	4	1	1	0	7
Johor, Melaka & Negeri Sembilan	6	2	1	0	0	1	0	1	0	1
TOTAL	64	5	3	13	3	12	3	3	1	21
The damages identified on buildings with ESE installation										
Selangor, Kuala Lumpur and Putrajaya	1	0	1	0	0	0	0	0	0	0
Kedah, Pulau Pinang and Perlis	0	0	0	0	0	0	0	0	0	0
Kelantan and Terengganu	0	0	0	0	0	0	0	0	0	0
Pahang	0	0	0	0	0	0	0	0	0	0
Perak	0	0	0	0	0	0	0	0	0	0
Johor, Melaka & Negeri Sembilan	2	0	1	0	0	1	0	0	0	0
TOTAL	3	0	2	0	0	1	0	0	0	0

RESEARCH FINDING

Research Objective 5: Finding on Buildings With Early Streamer Emission (ESE).

(Scope 12.3 and 12.4 of TOR)

To identify buildings having LPS where Early Streamer Emission (ESE), Franklin rod or Charge Transfer System (CTS) used as their air termination system.

[Untuk mengenalpasti bilangan dan jenis-jenis alat penangkap kilat yang di pasang di bangunan-bangunan seperti sistem Early Streamer Emission (ESE), kaedah rod Franklin dan Charge Transfer System (CTS).]

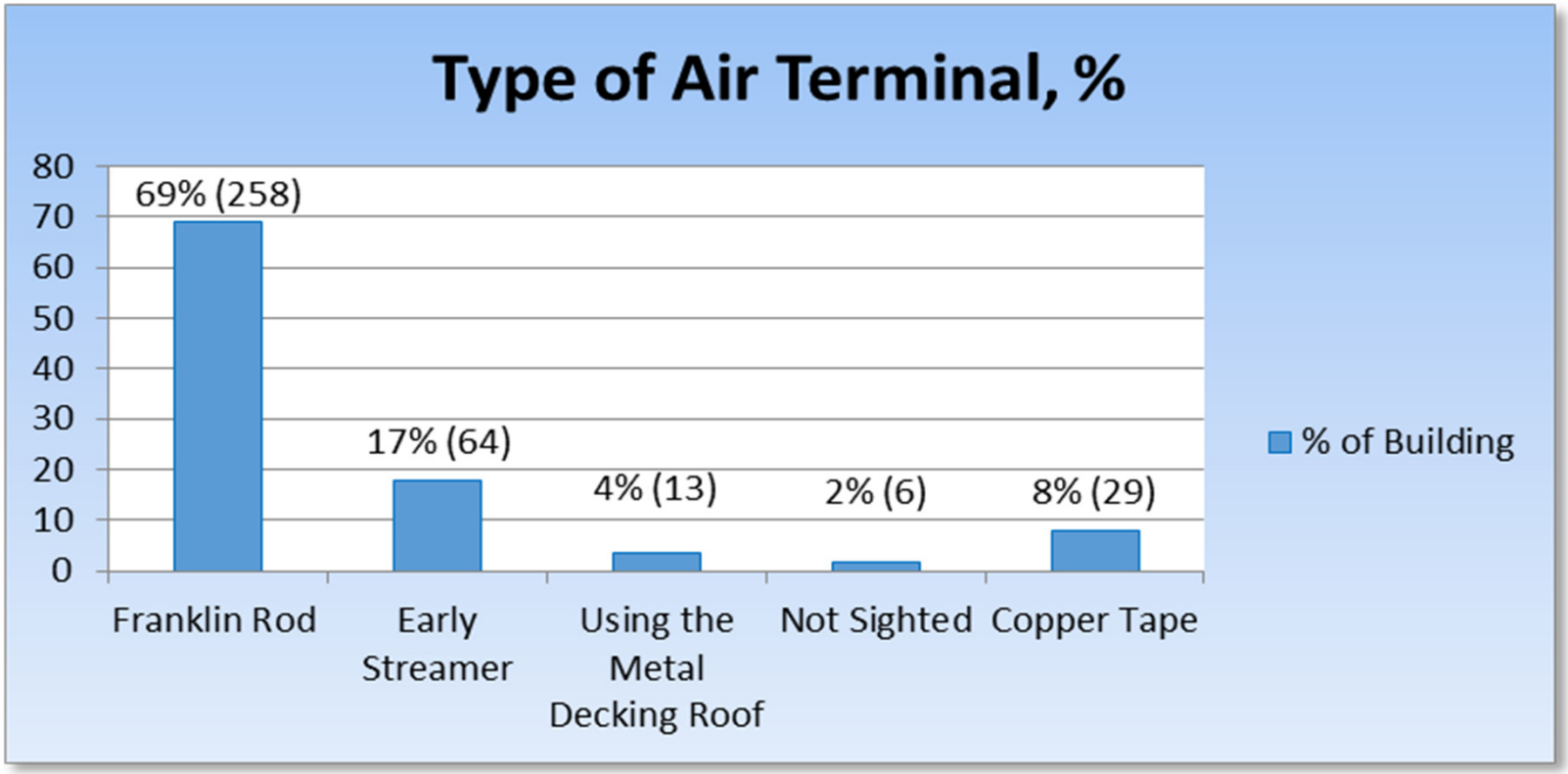


Figure 13: LPS type of air terminal in percentage

The choice on the selection of ESE by consultant design is tabulated in the Table below.

Table 4: Data percentage design by consultant and using early streamer.

CATEGORY	TOTAL BUILDING NUMBER	QUESTIONS					
		DESIGNED BY CONSULTANT?			USING EARLY STREAMER? (From 370 Buildings)		
		YES	NO	N/S	YES	N0	N/S
OFFICE	63	53	3	7	7	47	2
AIRPORT	7	7	-	-	1	6	0
CONDOMINIUM	4	4	-	-	-	3	1
GOVT OFFICE	55	48	1	6	6	43	0
HOSPITALS	20	20	-	-	3	16	0
SCHOOL / IPT	58	47	6	5	3	50	0
BUNGALOW & TERRACE	37	15	-	22	5	10	0
APARTMENT	31	28	1	2	3	26	0
BUSINESS COMPLEX	46	46	-	-	12	32	2
FACTORY	32	25	1	6	2	24	0
ENTERPRISE BUILDING	15	14	-	1	1	12	1
MUST VISIT + OTHERS	51	50	1	0	21	31	0
TOTAL	**419**	**357**	**13**	**49**	**64**	**300**	**6**
%		**86%**	**3%**	**11%**	**17%**	**81%**	**2%**
Y-YES		**N-NO**		**N/S – NOT SURE**			

RESEARCH FINDING

Research Objective 6: Findings on Compliance of Installation of Lightning Protection System and Its Components In Accordance With Relevant Standard.

(Scope 12.5 of TOR)

To identify the numbers and types of Lightning Protection System and its components which comes from an approved list according to the standard and Seksyen 47, Electricity Supply Act 1990 and Regulations of Electrical Installation 1994.

[Untuk mengenalpasti bilangan dan jenis-jenis alat penangkap kilat dan komponen-komponennya sama ada dari jenis yang diluluskan mengikut standard dan Seksyen 47, Akta Bekalan Elektrik 1990 dan Peraturan-Peraturan Elektrik 1994].

The component that has been identified as follows:-

1) Air terminal
2) Down conductor
3) Test point
4) Earthing system
5) Others accessories

Air Terminal

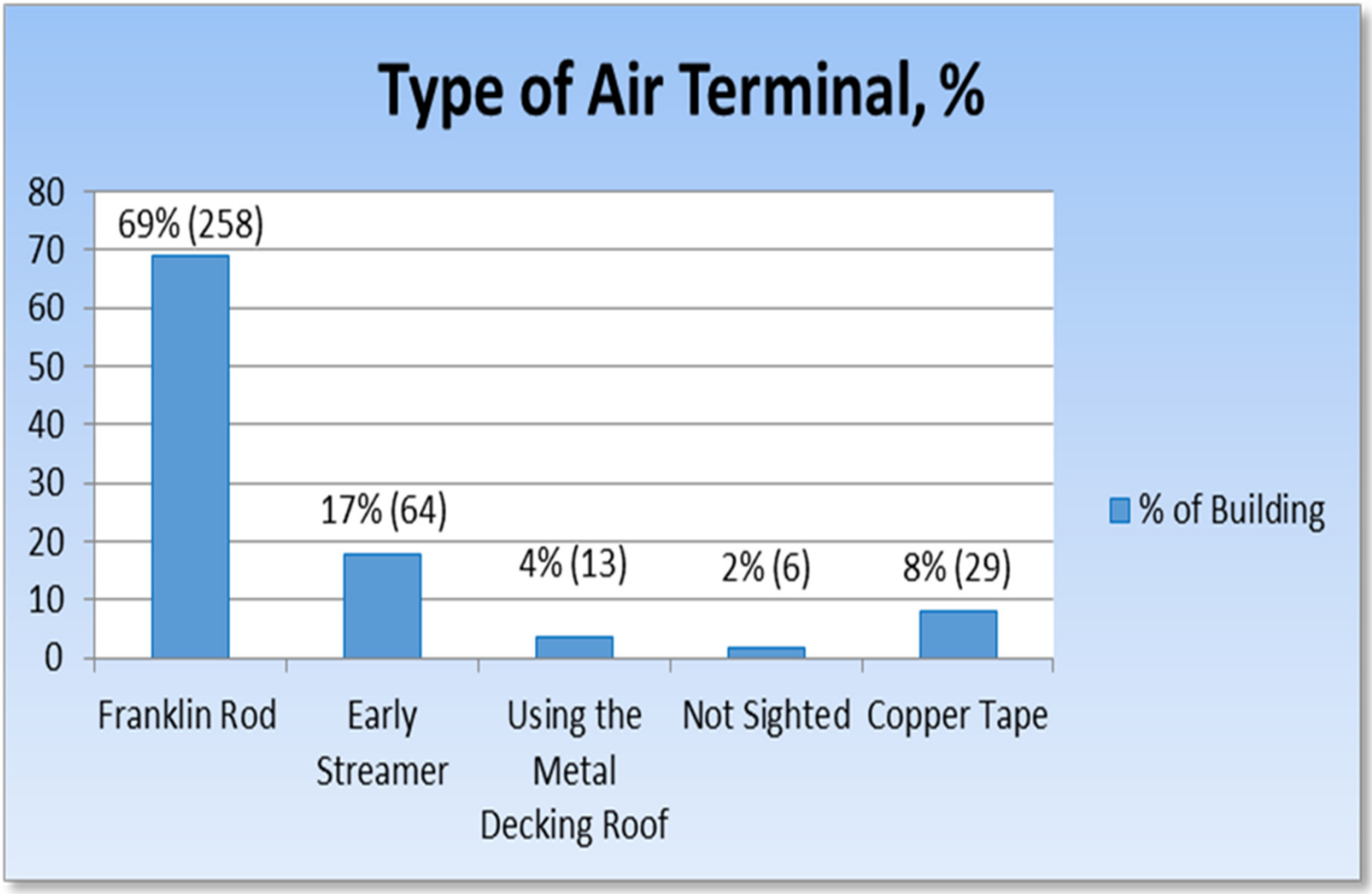


Figure 14: Type of air terminal

TYPE OF AIR TERMINAL

Building: KPJ Selangor Specialist Hospital.

The type of air terminal used at this building is franklin rod.

Building: Tesco Shah Alam.

The type of air terminal used is early streamer.

Building: Arkib Negara Pahang.

The type of air terminal used at this building is cooper tape. Cooper tape was lay on the top of roof.

Down Conductor

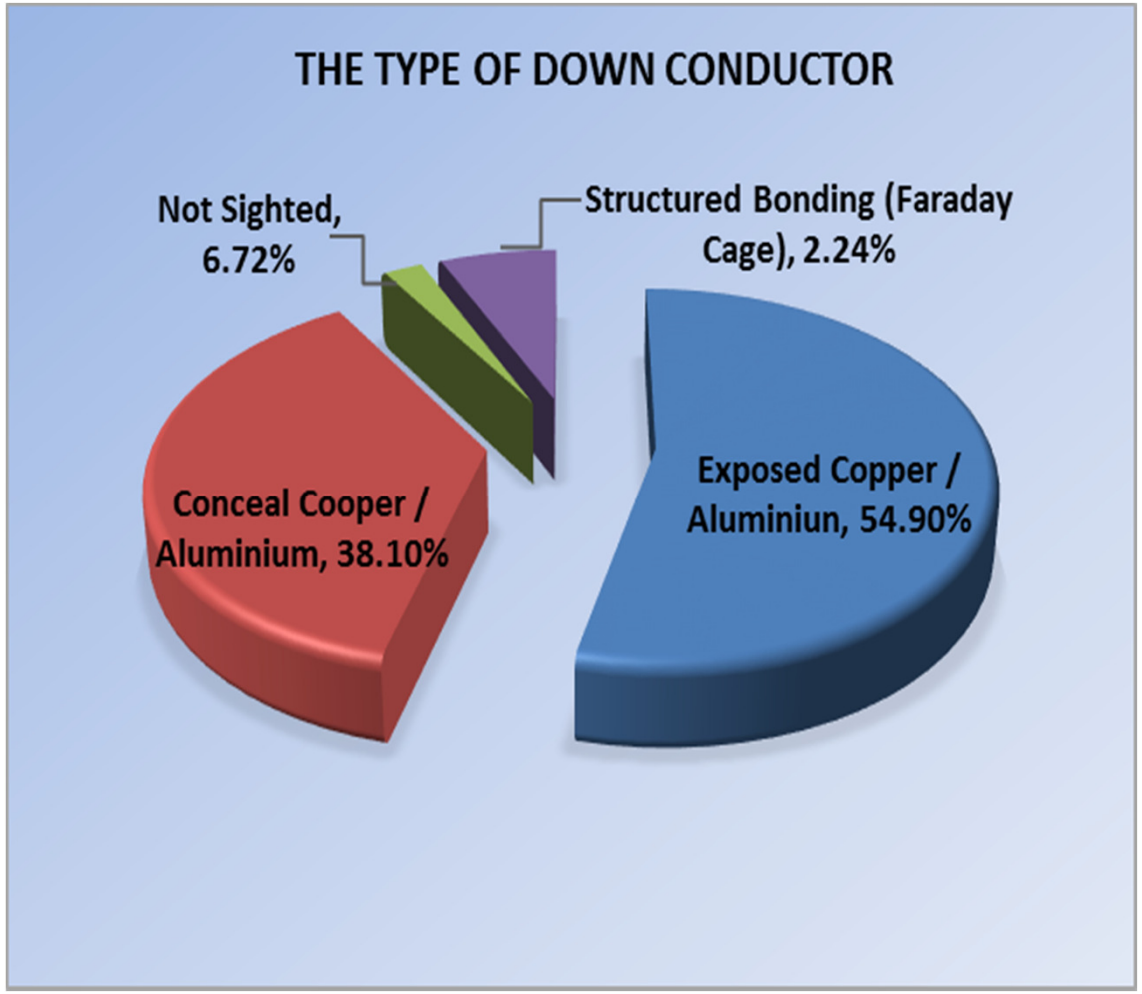


Figure 15: Type of Down Conductor

TYPE DOWN CONDUCTOR

Building: Wisma Persekutuan Terengganu.

Exposed down conductor has been used at this building.

Building: Jabatan Pembangunan USM.

Exposed down conductor partly concealed has been used at this building.

Building: Institut Latihan Perindustrian, Kangar, Perlis.

Concealed down conductor has been used at this building.

Building: Penang International Airport, Bayan Lepas.

Exposed down conductor has been used, where partly concealed inside a PVC casing.

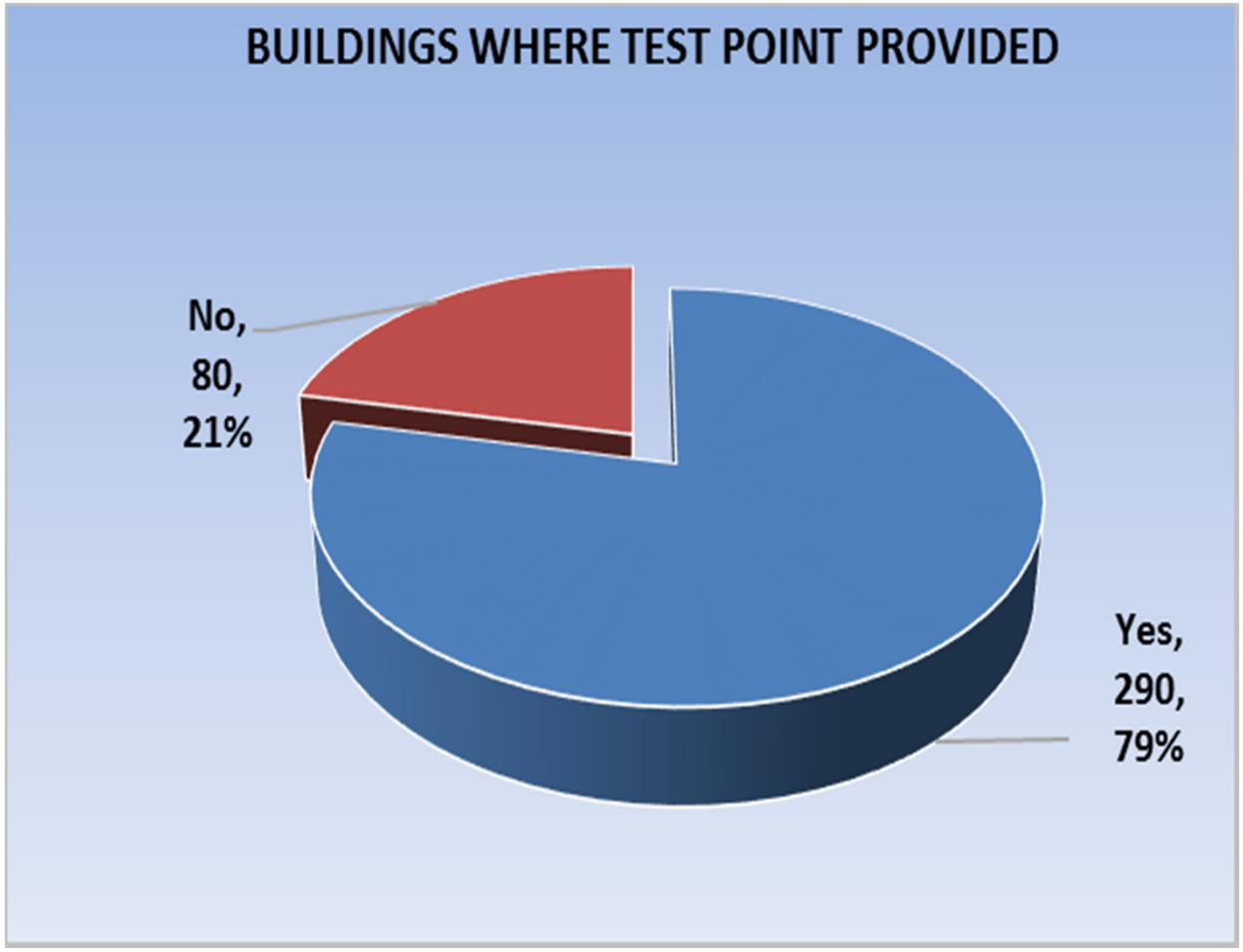


Figure 16: The provision of test points

TEST POINT

Building: Lapangan Terbang Sultan Haji Ahmad Shah.

Building: Pengurusan Air Pahang Berhad.

Building: Taman Perumahan Fera, Presint 8, Putrajaya.

Building: Rumah Pangsa Sri Suria.

Earthing System

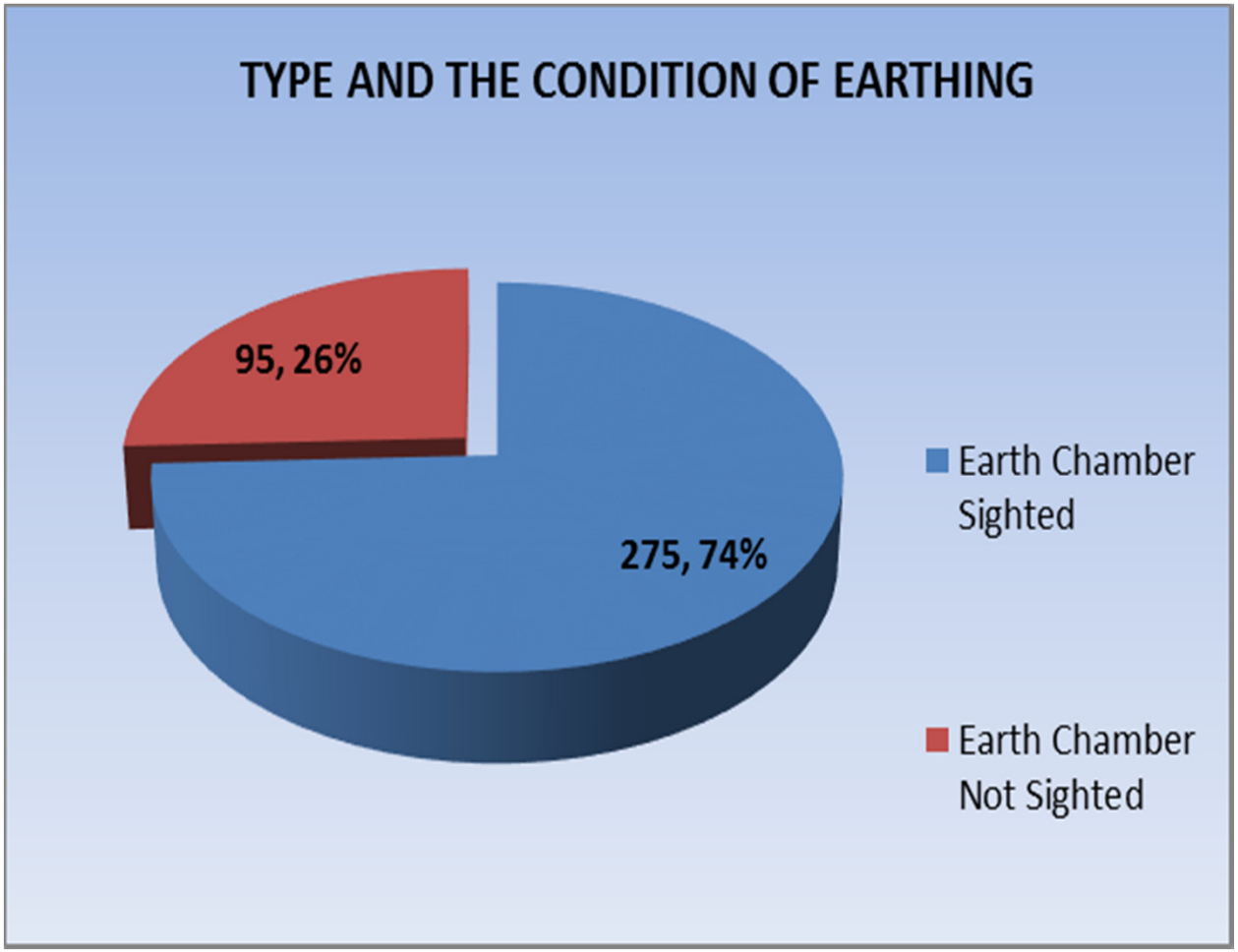


Figure 17: Type of earthing

EARTHING SYSTEM

Building: Kuarters guru, Parit Buntar.

Earth chamber for this building has been placed on the apron.

Building: Ameera Residence.

Earth chamber for this building has been placed on the ground.

Building: DEMC Selangor Specialist Hospital.

Earth chamber has been placed on walkway paver.

Building: Klinik Kesihatan Kangar, Perlis.

Earth chamber has been placed on road.

5) Others Accessories

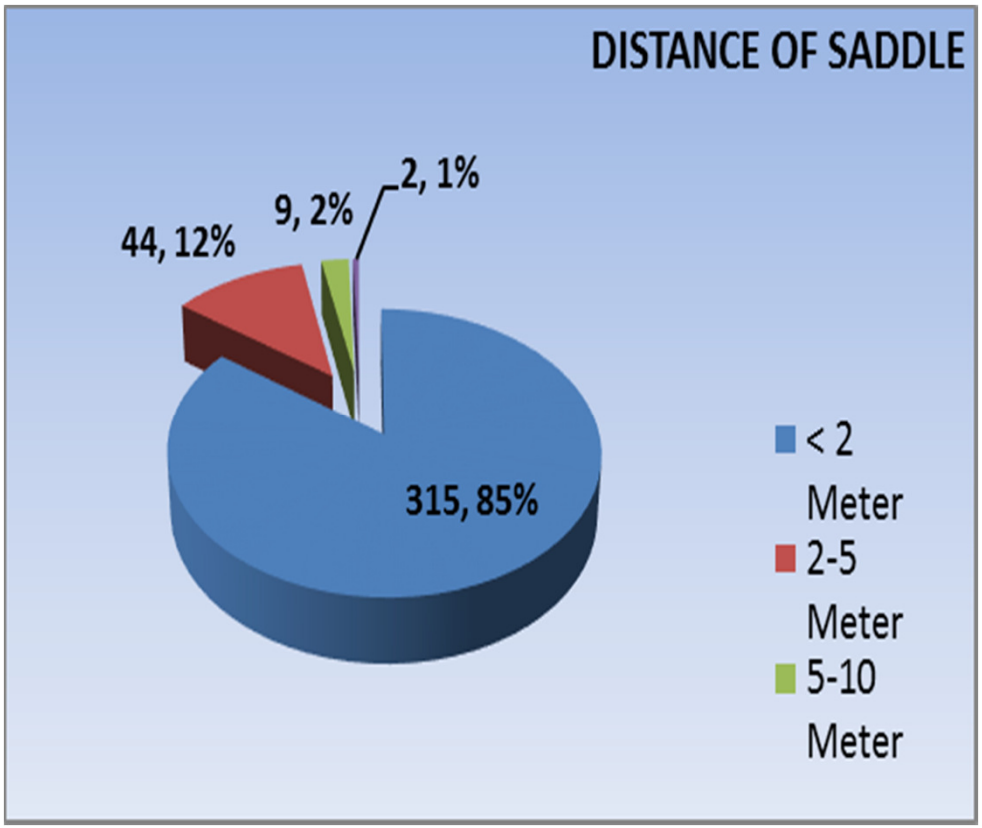


Figure 18: Distance of saddle

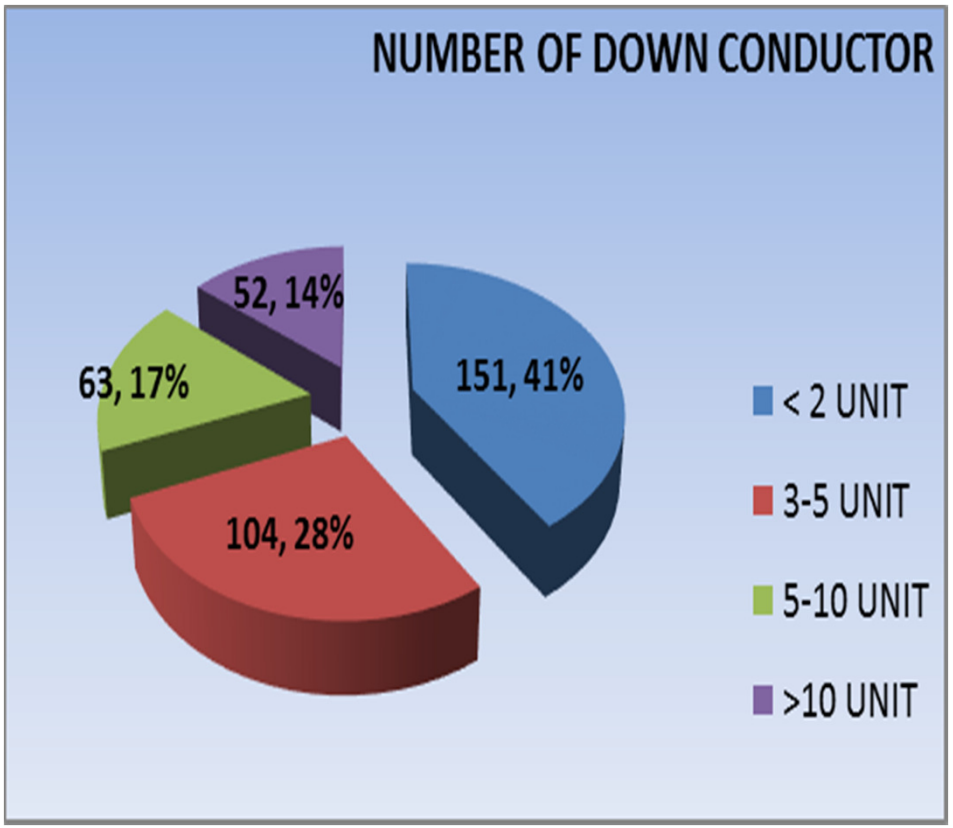


Figure 19: Numbers of down conductor

RESEARCH FINDING

Research Objective 7: Survey on Consumer's Understanding on The Importance of Lightning Protection System In Buildings.

(Scope 12.6 of TOR)

To identify the level of effectiveness of the installed LPS onto the buildings in providing the protection when lightning strike. Assessment must also be done on the physical damages to the buildings and all the electrical and electronic equipment installed in the buildings that incurred losses.

[Untuk mengenalpasti tahap keberkesanan sistem perlindungan kilat dalaman yang dipasang yang mencukupi bagi setiap bangunan dari panahan kilat yang boleh mendatangkan bencana kepada bangunan dan kemusnahan peralatan dalaman peralatan elektrik, komunikasi dan elektronik yang boleh menyebabkan kerugian yang besar].

Table 5: Consumers' Understanding on Lightning Protection System

QUESTIONS	ANSWER	Selangor, K.Lumpur&Putrajaya	Kedah, P. Pinang and Perlis	Kelantan and Terengganu	Pahang	Perak	Johor ,Melaka & N. Sembilan	TOTAL
Aware about MS IEC 62305	YES	25	26	27	26	25	25	154
	NO	30	29	28	29	29	29	174
	NOT SURE	15	16	15	15	15	15	91
Agree that LPS effectively protect buildings	YES	76	55	56	37	59	36	319
	NO	2	2	1	2	1	1	9
	NOT SURE	22	5	4	5	4	2	42
Agree on the importance of LPS installation	YES	84	96	53	35	59	36	363
	NO	9	10	2	4	2	2	29
	NOT SURE	9	8	2	4	2	2	27
Understand the effect of lightning on human	YES	109	105	57	37	59	36	403
	NO	1	3	1	2	1	1	9
	NOT SURE	1	2	1	1	1	1	7
Agree on LPS installation at high-rise buildings or buildings located at highlands	YES	104	105	57	37	55	36	394
	NO	2	1	1	1	2	2	9
	NOT SURE	1	1	3	5	3	3	16
Willing to invest on LPS installation according to MS IEC 62305	YES	26	26	28	29	29	29	168
	NO	25	10	20	7	10	15	87
	NOT SURE	25	28	28	29	27	29	164

CONCLUSIONS

In general the survey results and findings can be concluded as follows:

1) Total numbers of building visited during the survey was 419 building comprising 9 categories all together by both face to face interview and observation visit.

2) The percentages of buildings installed with LPS were found 88% (370 from visited 419 buildings) of which 83% (306) buildings and 17% (64) buildings were using conventional method and non-conventional method respectively. It was also found that 85.2% (357 of 419 buildings) of which LPS installed was designed by Consultant.

3) The results show even 88% of the building installed with LPS from 419 visited buildings, for both conventional and non-conventional recorded physical damage to the buildings at cumulative 6% (25 cases) from all 419 visited buildings.

4) There was also no record of the fatality as result of lightning in those buildings installed with LPS.

5) The components used in LPS, installed on the building using the conventional method are all confirm to the standard requirement with regards to material used and method of installation. The percentage of building which complied with the minimum to the Standard was found at 83% and used conventional rather that non-conventional method.

6) With regards to protection of equipment against lightning surges, 45% buildings installed with SPD and the operation interruption was 45% and equipment damages were 17%.

7) The public awareness on the LPS Standard is only 37% but 83% of buildings LPS installed confirmed to the Standard of practice i.e. IEC 62305. There was found that 293 building out of 370, i.e. 79% of the installed system designed by a consultant who are familiar with the Standard which found using conventional method.

8) The respondents do believe that LPS installed at their premises provide protection to the building as 86% agreed to the statement.

9) Almost everybody knew the effect of lightning on human being and 96% respondent agreed.

10) The percentages of respondent willing to invest on LPS is low at only 40%, the rest possibly have no idea about LPS and also do not see the benefit of the installation.

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THE END