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## LAMPIRAN

Lampiran 1 Tabel Kalibrasi Sensor ZH03B

| No        | Sensor Debu<br>( $\mu\text{g}/\text{m}^3$ ) | <i>Dust Collector</i><br>( $\mu\text{g}/\text{m}^3$ ) | Selisih | <i>Error</i> |
|-----------|---|---|---------|--------------|
| 1         | 0,19  | 0,16  | 0,03    | 18,75%       |
| 2         | 0,81  | 0,75  | 0,06    | 8,00%        |
| 3         | 1,23  | 1,21  | 0,00    | 1,65%        |
| 4         | 2,31  | 2,11  | 0,20    | 9,48%        |
| 5         | 3,41  | 3,52  | 0,10    | 3,13%        |
| 6         | 4,52  | 4,51  | 0,00    | 0,22%        |
| 7         | 7,51  | 7,54  | 0,00    | 0,40%        |
| 8         | 9,83  | 9,53  | 0,30    | 3,15%        |
| 9         | 12,61                                       | 12,57   | 0,00    | 0,32%        |
| 10        | 15,98                                       | 15,21   | 0,80    | 5,06%        |
| 11        | 20,61                                       | 21,11   | 0,50    | 2,37%        |
| 12        | 33,04                                       | 34,51   | 1,50    | 4,26%        |
| 13        | 41,59                                       | 40,65   | 0,90    | 2,31%        |
| 14        | 48,31                                       | 45,67   | 2,60    | 5,78%        |
| 15        | 53,21                                       | 50,55   | 2,70    | 5,26%        |
| 16        | 62,12                                       | 60,48   | 1,60    | 2,71%        |
| 17        | 73,51                                       | 70,53   | 3,00    | 4,23%        |
| 18        | 86,11                                       | 80,53   | 5,60    | 6,93%        |
| 19        | 93,57                                       | 90,50   | 3,10    | 3,39%        |
| 20        | 100,75                                      | 99,21   | 1,50    | 1,55%        |
| Rata-rata |   |   | 1,20    | 4,45%        |

**Lampiran 2 Tabel Kalibrasi Sensor DS18B20**

| No        | Sensor DS18B20 (°C) | Termometer (°C) | Selisih | Error  |
|-----------|---------------------|-----------------|---------|--------|
| 1         | 0,30                | 0,20            | 0,10    | 50,00% |
| 2         | 5,50                | 5,30            | 0,20    | 3,77%  |
| 3         | 9,70                | 10,10           | 0,40    | 3,96%  |
| 4         | 15,90               | 15,40           | 0,50    | 3,25%  |
| 5         | 21,40               | 20,20           | 1,20    | 5,94%  |
| 6         | 25,20               | 25,60           | 0,40    | 1,56%  |
| 7         | 30,70               | 30,40           | 0,30    | 0,99%  |
| 8         | 35,10               | 35,70           | 0,60    | 1,68%  |
| 9         | 41,20               | 40,10           | 1,10    | 2,74%  |
| 10        | 45,80               | 45,40           | 0,40    | 0,88%  |
| 11        | 51,60               | 50,10           | 1,50    | 2,99%  |
| 12        | 55,80               | 55,20           | 0,60    | 1,09%  |
| 13        | 60,80               | 60,50           | 0,30    | 0,50%  |
| 14        | 66,20               | 65,60           | 0,60    | 0,91%  |
| 15        | 73,10               | 70,30           | 2,80    | 3,98%  |
| 16        | 76,10               | 75,90           | 0,20    | 0,26%  |
| 17        | 80,50               | 80,20           | 0,30    | 0,37%  |
| 18        | 86,00               | 85,90           | 0,10    | 0,12%  |
| 19        | 91,10               | 90,90           | 0,20    | 0,22%  |
| 20        | 99,60               | 100,30          | 0,70    | 0,70%  |
| Rata-rata |                     |                 | 0,35    | 3,94%  |

**Lampiran 3 Tabel Kalibrasi Sensor BH1750**

| No | Sensor BH1750 (Lux) | Lux Meter (Lux) | Selisih | Error  |
|----|---------------------|-----------------|---------|--------|
| 1  | 0,20                | 0,40            | 0,20    | 50,00% |
| 2  | 10,00               | 15,00           | 2,00    | 7,69%  |
| 3  | 24,00               | 26,00           | 2,00    | 3,51%  |
| 4  | 59,00               | 57,00           | 1,00    | 1,09%  |

|           |     |     |      |       |
|-----------|-----|-----|------|-------|
| 5         | 91  | 92  | 1,0  | 1,09% |
| 6         | 154 | 155 | 1,0  | 0,65% |
| 7         | 201 | 203 | 2,0  | 0,99% |
| 8         | 257 | 260 | 3,00 | 1,15% |
| 9         | 301 | 303 | 2,00 | 0,66% |
| 10        | 355 | 354 | 1,00 | 0,28% |
| 11        | 402 | 403 | 1,00 | 0,25% |
| 12        | 457 | 452 | 5,00 | 1,11% |
| 13        | 508 | 507 | 1,00 | 0,20% |
| 14        | 552 | 557 | 5,00 | 0,90% |
| 15        | 603 | 608 | 5,00 | 0,82% |
| 16        | 655 | 659 | 4,00 | 0,61% |
| 17        | 701 | 709 | 8,00 | 1,13% |
| 18        | 748 | 756 | 8,00 | 1,06% |
| 19        | 798 | 802 | 4,00 | 0,50% |
| 20        | 850 | 857 | 7,00 | 0,82% |
| Rata-rata |     |     | 3,20 | 0,36% |

#### Lampiran 4 Program Mikrokontroler ESP32

```
#include <DallasTemperature.h>
#include <DallasTemperature.h>
//VARIABLE JARINGAN
#include <WiFi.h>
#include <HTTPClient.h>
const char* ssid = "smart"; //ssid wifi bisa diganti
const char* password = "smart123"; //pass wifi bisa diganti
const char* serverName = "http://environmentalmonitoring.my.id"; //ubah sesuai
alamat ip laptop
String url="";
String payload;
```

```

String lastPayload;
unsigned long millisWeb;
bool espStart = true;
HTTPClient http;
WiFiClient client;
int millisCount = 0;
String server_state = "ERR";
String wifi_state = "ERR";
int koneksi_ulang;
//VARIABLE DISPLAY LCD
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
int lcdCount = 0;
unsigned long lcdMillis;
//PROGRAM LUX METER
#include <BH1750.h> //Memasukkan library BH1750 kedalam proyek ini
BH1750 lightMeter; //Memanggil library BH1750 dengan nama
lightMeter
float lux;
//VARIABLE SENSOR SUHU
#include <OneWire.h>
#include <DallasTemperature.h>
#define pinSuhu 5
#define ONE_WIRE_BUS pinSuhu
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature senSuhu(&oneWire);
double currSuhu;
//VARIABLE GPIO PIN
#define RXD2 16
#define TXD2 17

```

```

#define pinPB1    34
#define pinPB2    35
#define pinPB3    32

#define pinBuzzer 33

//VARIABLE SENSOR DEBU ZH03B
#define zh03Serial Serial2

float ZHPM10,ZHPM25,ZHPM100,ZHTotal;
struct zh03bData {
    uint16_t framelen;
    uint16_t pm10_standard, pm25_standard, pm100_standard;
    uint16_t pm10_env, pm25_env, pm100_env;
    uint16_t particles_03um, particles_05um, particles_10um, particles_25um,
particles_50um, particles_100um;
    uint16_t unused;
    uint16_t checksum;
};
struct zh03bData data;
bool pbVal1,pbVal2,pbVal3;
int dustResult;
void setup() {
    Serial.begin(9600);
    zh03Serial.begin(9600, SERIAL_8N1, RXD2, TXD2);
    pinMode(pinPB1, INPUT_PULLUP);
    pinMode(pinPB2, INPUT_PULLUP);
    pinMode(pinPB3, INPUT_PULLUP);
    pinMode(pinBuzzer, OUTPUT);
    digitalWrite(pinBuzzer, LOW);
    Wire.begin();
    lightMeter.begin();
    lcd.begin();

```



```

lcd.setCursor(0, 0);
lcd.print(" ENV MONITORING ");
lcd.setCursor(0, 1);
lcd.print("  SYSTEM  ");
setup_wifi();
senSuhu.begin();
delay(2000);
lcd.clear();
beep(1);
}
void loop() {
//BACA SUHU=====
senSuhu.requestTemperatures();
currSuhu = senSuhu.getTempCByIndex(0);
//=====
lux = lightMeter.readLightLevel();
lux = lux * 1.125;
// dustResult = getDust();
if (readPMSdata(&zh03Serial)){
  Serial.print("PM 1.0: "); Serial.print(data.pm10_standard);
  Serial.print("\t\tPM 2.5: "); Serial.print(data.pm25_standard);
  Serial.print("\t\tPM 10: "); Serial.println(data.pm100_standard);
  ZHPM10 = data.pm10_env;
  ZHPM25 = data.pm25_env * 0.7857;
  ZHPM100 = data.pm100_env;
  ZHTotal = ZHPM10 + ZHPM25 + ZHPM100;
  Serial.print("PM 1.0: "); Serial.print(ZHPM10);
  Serial.print("\t\tPM 2.5: "); Serial.print(ZHPM25);
  Serial.print("\t\tPM 10: "); Serial.println(ZHPM100);
  // Serial.print("Particles > 0.3um / 0.1L air:");
Serial.println(data.particles_03um);
}
}

```

```

    // Serial.print("Particles > 0.5um / 0.1L air:");
Serial.println(data.particles_05um);
    // Serial.print("Particles > 1.0um / 0.1L air:");
Serial.println(data.particles_10um);
    // Serial.print("Particles > 2.5um / 0.1L air:");
Serial.println(data.particles_25um);
    // Serial.print("Particles > 5.0um / 0.1L air:");
Serial.println(data.particles_50um);
    // Serial.print("Particles > 10.0 um / 0.1L air:");
Serial.println(data.particles_100um);
}
if (currSuhu > 30 || ZHTotal >10 || lux>600 ){
    digitalWrite(pinBuzzer, HIGH);
}else{
    digitalWrite(pinBuzzer, LOW);
}
if(millis() - millisWeb >= 3000){
    millisWeb = millis();
    zh03Serial.end();

    String responWeb = sendWeb();
    delay(100);
    zh03Serial.begin(9600, SERIAL_8N1, RXD2, TXD2);
}
displayLcd();
}
void beep(int a){
    for(int i=0;i<a;i++){
        digitalWrite(pinBuzzer, HIGH);
        delay(50);
        digitalWrite(pinBuzzer, LOW);
    }
}

```

```

delay(50);
}
}

```

**Lampiran 5 Tabel Hasil Pengukuran Kadar Debu**

| Menit | Kantor Staff K3 | Ruang Produksi<br>(Preheater) | Dekat Pemukiman |
|-------|-----------------|-------------------------------|-----------------|
| 7:00  | 19,80           | 6,63                          | 8,50            |
| 7:13  | 19,17           | 23,18                         | 6,63            |
| 7:39  | 13,31           | 4,76                          | 15,03           |
| 7:55  | 10,42           | 4,81                          | 13,51           |
| 8:36  | 7,24            | 9,74                          | 7,49            |
| 8:59  | 6,24            | 3,25                          | 11,26           |
| 9:32  | 6,44            | 8,12                          | 11,37           |
| 10:01 | 5,29            | 9,38                          | 12,52           |
| 10:30 | 5,65            | 8,87                          | 8,19            |
| 10:51 | 4,76            | 8,03                          | 6,23            |
| 11:23 | 5,24            | 17,88                         | 21,56           |
| 11:52 | 3,14            | 3,26                          | 21,67           |
| 12:08 | 3,19            | 6,76                          | 11,11           |
| 12:31 | 3,14            | 1,94                          | 4,97            |
| 12:42 | 3,54            | 11,79                         | 7,33            |
| 13:09 | 3,56            | 6,02                          | 11,79           |
| 13:24 | 3,51            | 0,45                          | 12,12           |
| 13:43 | 3,88            | 0,94                          | 4,76            |
| 13:55 | 3,29            | 6,87                          | 9,18            |
| 14:00 | 3,19            | 14,25                         | 8,12            |

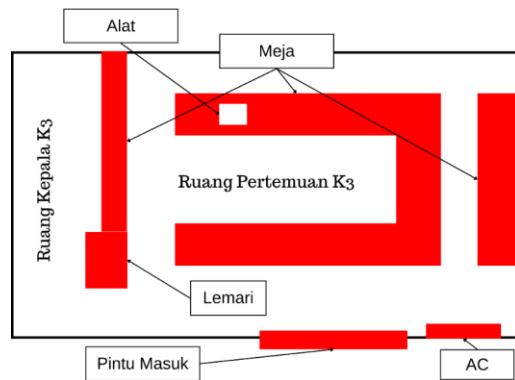
**Lampiran 6 Tabel Hasil Pengukuran Suhu**

| Menit | Kantor Staff K3 | Ruang Produksi<br>(Preheater) | Dekat Pemukiman |
|-------|-----------------|-------------------------------|-----------------|
| 7:00  | 28,71           | 33,40                         | 28,03           |
| 7:20  | 28,72           | 36,08                         | 28,78           |
| 7:43  | 28,49           | 38,01                         | 29,42           |
| 7:58  | 28,50           | 37,83                         | 30,29           |
| 8:12  | 28,39           | 38,81                         | 31,62           |
| 8:34  | 29,56           | 41,07                         | 32,63           |
| 8:56  | 29,86           | 36,61                         | 29,58           |
| 9:11  | 30,14           | 37,03                         | 30,04           |
| 9:35  | 30,19           | 40,55                         | 31,68           |
| 9:54  | 30,57           | 40,46                         | 29,83           |
| 10:13 | 31,36           | 41,11                         | 31,69           |
| 10:33 | 31,66           | 42,25                         | 31,68           |
| 10:54 | 32,21           | 38,30                         | 28,36           |
| 11:32 | 32,00           | 37,31                         | 28,73           |
| 11:57 | 31,78           | 40,43                         | 29,33           |
| 12:22 | 32,27           | 40,02                         | 30,07           |
| 12:57 | 31,44           | 41,39                         | 28,26           |
| 13:14 | 31,32           | 38,66                         | 29,46           |
| 13:39 | 31,58           | 37,90                         | 31,06           |
| 14:00 | 32,02           | 38,19                         | 31,42           |

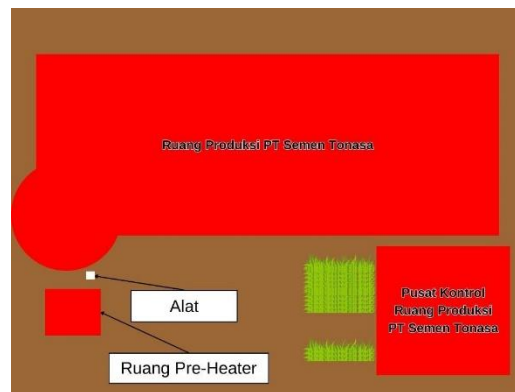
**Lampiran 7 Tabel Hasil Pengukuran Intensitas Cahaya**

| Menit | Kantor Staff K3 | Ruang Produksi<br>(Preheater) | Dekat Pemukiman |
|-------|-----------------|-------------------------------|-----------------|
| 7:00  | 95,19           | 34.702,97                     | 5.171,01        |
| 7:19  | 131,94          | 49.550,94                     | 7.704,50        |
| 7:43  | 126,94          | 53.884,75                     | 8.308,00        |
| 8:02  | 150,31          | 58.149,50                     | 15.763,19       |
| 8:23  | 154,86          | 61.439,06                     | 17.732,06       |
| 8:55  | 128,31          | 61.439,06                     | 10.634,00       |
| 9:14  | 164,44          | 61.439,06                     | 16.798,05       |
| 9:36  | 171,94          | 61.439,06                     | 19.048,65       |
| 9:55  | 170,74          | 61.439,06                     | 13.176,74       |
| 10:10 | 172,31          | 61.439,06                     | 16.923,51       |
| 10:38 | 175,67          | 61.439,06                     | 17.747,17       |
| 10:58 | 167,52          | 61.439,06                     | 6.567,31        |
| 11:13 | 47,56           | 61.439,06                     | 7.905,75        |
| 11:36 | 73,87           | 61.439,06                     | 8.461,64        |
| 11:52 | 72,87           | 61.439,06                     | 8.580,60        |
| 12:29 | 35,75           | 41.286,09                     | 16.934,47       |
| 13:00 | 34,13           | 61.439,06                     | 6.825,76        |
| 13:25 | 73,71           | 61.439,06                     | 13.395,12       |
| 13:41 | 80,06           | 45.399,84                     | 16.930,14       |
| 14:00 | 76,62           | 60.172,19                     | 19.153,63       |

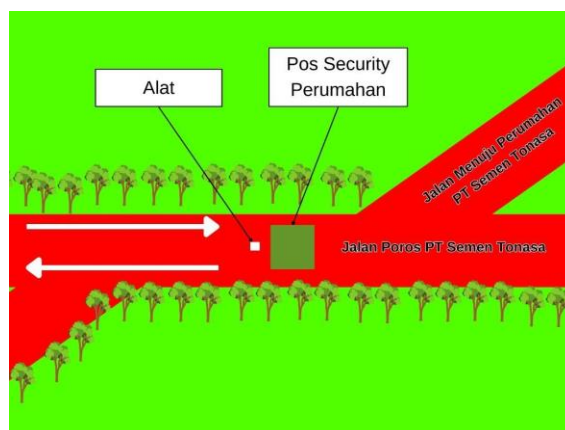
**Lampiran 8 Denah Ruangan 1 (Kantor K3 PT Semen Tonasa)**



**Lampiran 9 Denah Ruangan 2 (Ruang Produksi)**



**Lampiran 10 Denah Ruangan 3 (Dekat Pemukiman)**



**Lampiran 12 Lokasi Pengambilan Data PT Semen Tonasa**

