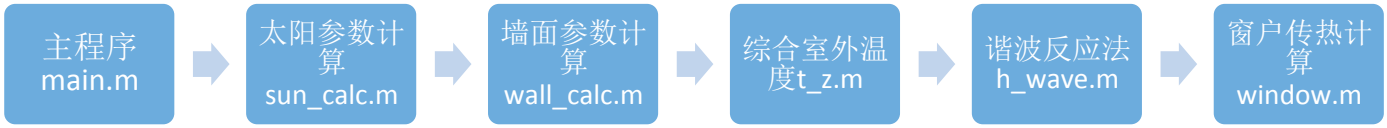

main.m

```
%---------------------------------------- 基本信息----------------------------------
% 1. 客机机头朝南放置；
% 2. 客机座舱壁简化为一保温材料，导热系数 0.05 W/m-K，厚度 120 mm，比热容 1.5kJ/kg-K，密度 2800 kg/m3。
% 3. 机舱两侧窗户面积 4.466 m2，驾驶舱窗户面积 1.5288 m2，窗户厚度为 60 mm。窗户玻璃的传热系数
可视为 1.71 W/m2-K，
%   窗户对太阳辐射的透过率为 0.8，吸收率为 0.08，反射率为 0.12。
% 4. 座舱外总换热系数 aa=18 W/m2-K，座舱内总换热系数 ar=8 W/m2-K。
% 5. 座舱外壁对太阳直射辐射的吸收率 aD=0.4，对天空散射辐射的吸收率 ad=0.3，对天空的辐射系统黑
度?0=0.4，
%      对地面的辐射系统黑度?g=0.12。大气透明系数 p=0.62。
% 6. 天津东经 117.2 度，北纬 39.1 度。
%----------------------------------------数组初始化----------------------------------
t = zeros(1,24);                %温度
t_k = zeros(1,24);
ea = zeros(1,24);               %水蒸气分压力
omega = zeros(1,24);            %真太阳时
h = zeros(1,24);                %太阳高度角
alpha = zeros(1,24);            %太阳方位角
m = zeros(1,24);                %大气质量
pm = zeros(1,24);
rsj = zeros(1,24);              %太阳入射角
Id0 = zeros(1,24);              % p15 2-16  太阳直射辐射强度
Idh = zeros(1,24);              % p15 2-19  天空散射辐射
tz    = zeros(1,24);            %室外空气综合温度
qs = zeros(1,24);               %围护结构外表面吸收太阳直射以及散射辐射
qr = zeros(1,24);               %围护结构外表面吸收地面反射辐射
qe = zeros(1,24);               %夜间辐射
HG_wall = zeros(1,24); %壁面传热量
HG_window = zeros(1,24);
HG_sum = zeros(1,24);
cita   =zeros(1,24);                    %当量温差
%----------------------------------------读入数据----------------------------------------
filename = 'heat.xlsm';
ta= xlsread(filename, 1,'B8:Y8');       %室外空气温度
t_k = ta +273.15;
ea = xlsread(filename,1,'B10:Y10');     %水蒸气分压力
%-------------------------------------------------------------------------------
```

```
  [omega,h,alpha,m,pm] = sun_calc();

  %[rsj, Id0,Idh] = wall_calc(h ,pm,wall_angle,sfw_angle);

  [rsj, Id0,Idh] = wall_calc(h ,pm,0,0);

[tz,qs,qr,qe]= t_z( Id0, Idh,Id0+Idh,t_k,ea);    %计算综合室外空气温度

  [HG_wall,cita] = h_wave(tz);

  %function [sun,tran ] = window(h,pm,ta,wall_angle,sfw_angle,F )
  [ sun_w,tran_w] = window(h,pm,ta,90, alpha-90, 4.466);
  [ sun_e,tran_e] = window(h,pm,ta,90, alpha+90, 4.466);
  [ sun_s,tran_s] = window(h,pm,ta,90, alpha, 1.5288);
  HG_window_tran = (tran_w)+ (tran_e)+(tran_s);
    HG_window_sun = (sun_w)+ (sun_e)+(sun_s);
  HG_sum = (-sun_w-tran_w)+ (-sun_e-tran_e)+(-sun_s-tran_s) - HG_wall;

  main_data =[omega                  %1
                    h                    %2
                    alpha               %3
                    rsj                  %4
                    m                    %5
                    pm                  %6
                    Id0                  %7
                    Idh                   %8
                    Id0+Idh             %9
                    ta                   %10
                    tz                    %11
                    qs                    %12
                    cita                  %13
                    HG_wall             %14
                    HG_window_tran      %15
                    HG_window_sun      %15
                    HG_sum               %15

                    ];

        xlswrite(filename,main_data,2,'E3');
```

sun_calc.m

```
function [omega,h,alpha,m,pm] = sun_calc( )
%UNTITLED2 Summary of this function goes here
%      Detailed explanation goes here
```

```
current_year = 2013;
current_month = 12;
current_day = 20;
jd = 117.2;          %东经
s_jd = 120;         %北京标准经度
wd = 39.1;           %北纬
p = 0.62;            %大气透明系数
%------------------------------数组初始化-------------------------
omega = zeros(1,24);   %真太阳时
h = zeros(1,24);                %太阳高度角
alpha = zeros(1,24);       %太阳方位角
m = zeros(1,24);               %大气质量
pm = zeros(1,24);

%-----------------------------------------------------------------------------------------
      n = days_calc(12,20);
      n0 = 79.6764 + 0.2422*(current_year-1985) - fix((current_year-1985)/4);   %年份修正
      t= n -n0;
      cita = 2*pi*t/(365.2422-0.3);       % -0.3 日 经度修正
cwj = 0.3723 + 23.2567*sin(cita)+
0.1149*sin(2*cita)-0.1712*sin(3*cita)-0.758*cos(cita)+0.3656*cos(2*cita)+0.0201*cos(3*cita);

      e = 0.0028 - 1.9857*sin(cita)+9.9059*sin(2*cita)-7.0924*cos(cita)-0.6882*cos(2*cita);
%-----------------------------------------------------------------------------------------
 for ii = 1:24
         omega(ii) = ((ii-1) + (jd - s_jd)/15 + e/60 -12)*15;                          % p8 2-3  真太阳时
         h(ii) = asind(sind(wd)*sind(cwj)+cosd(wd)*cosd(cwj)*cosd(omega(ii)));   % p8 2-4  太阳高度角
         alpha(ii) = asind(cosd(cwj)*sind(omega(ii))/cosd(h(ii)));                % p9 2-5  太阳方位角
         m(ii) = 1/sind(h(ii));                                                    % p15 2-15  大气质量
         pm(ii) = p^m(ii);

 end
 end
function [n] = days_calc(current_month,current_day)
      days = [ 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31];
      n = 0;
      for ii = 1:(current_month-1)
            n = n + days(ii);
      end
      n = n+ current_day;
end
```

wall_calc.m

```
function [rsj, Id0,Idh ] = wall_calc( h ,pm,wall_angle,sfw_angle)
%UNTITLED3 Summary of this function goes here
%     swf_angle  壁面太阳方位角    wall_angle  壁面倾角

I0 = 1353;            %太阳辐射常数
p = 0.62;             %大气透明系数

%------------------------------数组初始化-------------------------
rsj = zeros(1,24);              %太阳入射角
Id0 = zeros(1,24);            % p15 2-16  太阳直射辐射强度
Idh = zeros(1,24);          % p15 2-19  天空散射辐射

for ii = 1:24
  if    (h(ii)<=0 )
            rsj(ii) = 0;
            Id0(ii) = 0;
            Idh(ii) = 0;
      else
            rsj(ii)  =  acosd(cosd(wall_angle)*sind(h(ii))+sind(wall_angle)*cosd(h(ii))*cosd(sfw_angle)); %  p9  2-7  太
阳入射角
            Id0(ii) = I0*pm(ii)*cosd(rsj(ii));    % p15 2-16  太阳直射辐射强度
            Idh(ii) = 0.5*I0*sind(h(ii))*(1-pm(ii))/(1-1.4*log(p));    % p15 2-19  天空散射辐射
  end
end

end
```

t_z.m

```
function [tz,qs,qr,qe] =t_z( Id0,Idh,Ish,Ta ,ea)
%UNTITLED2 Summary of this function goes here
%     Detailed explanation goes here
      a_a = 18;             %座舱外总换热系数
      ad1 = 0.4;           %座舱外壁对太阳直射辐的吸收率
      ad2 = 0.3;                  %对天空散射辐的吸收率
      Cb= 5.67;                  % w/㎡·k4    黑体辐射常数
      pg = 0.2 ;
      cita = 0;                   %  与水平面成 cita 倾角的斜面所接受的地面反射辐射强度
      eo =    0.4;                %座舱外壁对天空的辐射系统黑度
      eg =      0.12;              %座舱外壁对地面的辐射系统黑度
      eos = eo;                    % p29 line 1
      eog = eo*eg;                 %  围护结构外表面与地面间的 p29 line3
      aos =1;                      %      aos+aog = 1  垂直壁面  aos = aog = 0.5  水平屋面  aos =1 aog =0
      aog =0;
```

```
    tz = zeros(1,24);
    qs = zeros(1,24);     %围护结构外表面吸收太阳直射以及散射辐射
    qr = zeros(1,24);     %围护结构外表面吸收地面反射辐射
    qe = zeros(1,24);     %夜间辐射
    %--------------------------------------------------------------------------------
    for ii = 1:24
        Ts = (0.51+0.208*sqrt(ea(ii)))^(0.25)*Ta(ii); %      p17 2-27  天空当量温度
        Tg = Ta(ii);
        qs(ii) = ad1*Id0(ii)+ad2*Idh(ii);    % p27 line 1
        qr(ii)= ad2*(pg)*Ish(ii)*(1-(cosd(cita/2))^2); % p27 line 4
        qe(ii) = Cb*eo*(Ta(ii)/100)^4 - Cb*eos*aos*(Ts/100)^4 - Cb*eog*aog*(Tg/100)^4;    % p29 2-54  夜间辐
射
        tz(ii) = (Ta(ii)-273.15) + (qs(ii)+qr(ii))/a_a - qe(ii)/a_a; % p29 2-55      室外空气综合温度
    end

end
```

h_wave.m

```
function    [HG,cita] = h_wave( tz )
%求衰减倍数和相位延迟
%     Detailed explanation goes here
    T=24;
    a_a = 18;                                %座舱外总换热系数  w/m^2.k
    a_r = 8;                                 %座舱内总换热系数  w/m^2.k
    lamda = 0.05;                            %座舱壁导热系数
    c = 1500    ;                            %比热容  kj/kg·k
    l=0.12;                                  %厚度
    p = 2800;                                %  密度  kg/m^3
    a = lamda/(p*c)*3600;                     %导温系数  m^2/h
    K = (1/a_a+l/lamda+1/a_r)^(-1);          %传热系数  w/m^2.k
    F = 245;                                  %板壁围护结构的面积  m^2
    tr = 20 ;                                 %室内温度恒定为 20 度
    average_tz = mean(tz);                   %室外空气平均综合温度
    %-------------------------------------------------
    v=zeros(1,12); %衰减倍数
    fi=zeros(1,12); %时间延迟

    an=zeros(1,12);
    bn=zeros(1,12);
    A=zeros(1,12);       %第 n 阶正弦波外扰振幅      oc
    Fi=zeros(1,12);      %第 n 阶正弦波外扰初相位  rad
    cita=zeros(1,24);     %各个时刻当量温差
```

```
HG = zeros(1,24);   %传热得热量
%-------------------------------------------------------------
%传递矩阵
syms s;
G3=[1,     -1/a_r;
      0,       1];

G2=[cosh(sqrt(s/a)*l),   -sinh(sqrt(s/a)*l)/(lamda*sqrt(s/a));
      -lamda*sqrt(s/a)*sinh(sqrt(s/a)*l),   cosh(sqrt(s/a)*l)];

G1=[1,     -1/a_a;
    0,                1];

G=G3*G2*G1;
B=-G(1,2);
   for n=1:12
   v(n)=a_r*abs(subs(B,s,i*n*2*pi/24));   % p62 3-40-2
   fi(n)=angle(subs(B,s,i*n*2*pi/24));       %p62 3-40-1
   end

%傅里叶级数展开
for n=1:12
      for j=0:23
            an(n)=an(n)+(2/T)*tz(j+1)*cos(n*2*pi/24*j);
            bn(n)=bn(n)+(2/T)*tz(j+1)*sin(n*2*pi/24*j);
      end
      A(n)=sqrt(an(n)^2+bn(n)^2);            %第 n 阶正弦波外扰振幅      oc
      Fi(n)=atan(an(n)/bn(n));                 %第 n 阶正弦波外扰初相位  rad

end

for j=0:23
      cita(j+1) = average_tz - tr;
      for n=1:12
            cita(j+1) = cita(j+1) + (a_r/K) * A(n)    / v(n) * sin(n*2*pi/24*j+Fi(n)-fi(n)); % p68 3-46  各个时刻当
量温差
      end
      HG(j+1) = K*F*cita(j+1); % p67 3-43
end
end
```

window.m

```
function [sun,tran ] = window(h,pm,ta,wall_angle,sfw_angle,F )
%通过玻璃窗的太阳辐射热量，  透过玻璃窗的太阳辐射得热
```

```
%     Detailed explanation goes here
a_a = 18;                                %座舱外总换热系数  w/m^2.k
a_r = 8;                                  %座舱内总换热系数  w/m^2.k
Ra = 1/a_a;
Rr    = 1/a_r;
tr = 20;                                 %室内温度恒定 20
td1 = 0.8;                              %  玻璃对入射角为 i 的太阳直射辐射透射率
td2 =td1;                               %  玻璃对太阳散射辐射透射率
ad1 = 0.08;                            %  玻璃对入射角为 i 的太阳直射辐射吸收率
ad2     =ad1;                           %  玻璃对太阳散射辐射吸收率
K = 1.71;                               %窗户玻璃传热系数
%------------------------------数组初始化--------------------------
rsj = zeros(1,24);
Id1 = zeros(1,24);
Id2 = zeros(1,24);
tran = zeros(1,24); %传热引起的窗玻璃传热量
sun = zeros(1,24); %由太阳辐射引起的窗玻璃传热
for ii = 1:24
    %[rsj, Id0,Idh] = wall_calc(h ,pm,wall_angle,sfw_angle);
    [rsj,Id1,Id2] = wall_calc(h ,pm,wall_angle,sfw_angle(ii));
    tran(ii) = K*F*(ta(ii)-tr);          %  传热量  p31 2-58
    sun(ii)= F*(Id1(ii)*(td1+(Ra/(Ra+Rr))*ad1)+Id2(ii)*(td2+(Ra/(Ra+Rr)*ad2)));    % p32 2-62
end
end
```