Influence of geometry and ventilation boundaries on simulation of the flow outside a room set-up in laboratory environment

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Influence of geometry and ventilation boundaries on simulation of the flow outside a room set-up in laboratory environment

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Abstract

In this study, the results from simulations of two sets of a 1/2 scale ISO room (ISO 9705) experiments are presented. In the experiments, heptane in a tray was burned in the middle of the room. Five models with various levels of complexity and geometric detail are used.

The comparisons between simulations and experiments show that the fourth model provides the most accurate results with deviation of 7.5%. In this model, the hood, air supplier, and platform are included and the model has finer details than the other simulations. On the other hand, the largest deviation between the numerical results and the experiments were found in the second mode and it should be considered as an example of a not perfect choice.

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(30/4/2012)

Parinaz Hemmati

Abstract in mother language (Persian):

در این تحقیق، نتایج سیمولیشن برای دو سری آزمایش در ISO room ارائه میشود که نتایج گرفته شده از سوزاندن سوخت هپتان در وسط اتاق آزمایش مدلسازی شده است. پنج مدل که در هر قدم جزئیات بیشتری به مدل اضافه شده درنرم افزار FDS شبیه سازی شده است.

نتایج مقایسه شبیه سازی در نرم افزار با آزمایش، نشان می دهد که مدل چهارم که کاملترین مدل بوده و در آن هود، داکت ،سیستم تامین کننده هوا و سکوی زیر اتاق در نظر گرفته شده است حدود 7.5% خطا دارد.از طرف دیگر ،مدل دوم با اینکه در مقایسه با مدل اول به جزئیات بیشتری توجه شده است ولی در آن از سیستم تامین کننده هوا و سکوی زیر اتاق چشم پوشی شده است، بالاترین خطا را دربین همه مدلها در حل عددی نشان میدهد و مدل نامناسبی برای انتخاب است.

همچنین، مدل اول که ساده ترین مدل بوده و در آن فقط اتاق شبیه سازی شده و از هود،داکت ،سیستم تامین کننده هوا و سکوی زیر اتاق چشم پوشی شده است حدود17-21% درصد با آزمایش خطا دارد.قابل ذکر است که در همه مدلها، بیشترین خطا در نزدیکی صفحه خنثی یا neutral plane وجود دارد.

اگرچه شبیه سازی جزئیات در سیمولشن دارای اهمیت است اما سایز مش (grid resolution) نیز از پارامترهای تعیین کننده برای دستیابی به نتایج بهتر است .که با آزمایش grid resolution مشخص گردید که این پارامتر به همراه مدلسازی جزئیات باهم مورد نیاز برای گرفتن نتایج بهتر است.

مدل پنجم (که در آن فقط برای اتاق سکو مدل شده است) برای بهینه سازی آزمایشگاه موجود یا طراحی جدید در ساختن آزمایشگاههای جید پیشنهاد میشود.

استفاده از حل عددی و شبیه سازی تمامی جزئیات مانند هود، داکت ،سیستم تامین کننده هوا و سکوی زیر اتاق می تواند یکی از طرحهای بهینه سازی اتاق آزمایش قبل از ساختن آزمایشگاه باشد .به عنوان مثال حل عددی مشخص نمود که با کاهش طول سکوی زیر اتاق آزمایش هوای بیشتری وارد اتاق شده واحتراق بصورت کاملتر در آزمایش سوخت هپتان باموقعیت قرارگیری در مرکز اتاق انجام میشود.

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1 Introduction & Objectives

The introductory chapter will specify the purpose of the thesis, problem description and give some brief information about the objective. In addition, a summary of the results from previous studies about validation of FDS and different grid sizes is presented.

Nowadays, FDS (Fire Dynamics Simulator) is a tool for researchers and engineers to study the behavior of fire, and a help to solving problems. Moreover, it is often used in performance-based design in order to prove safety in innovative design. Although, FDS has solved many problems in engineering approach, some questions about validation have remained without answer. One of the main questions for fire safety engineers and researchers are what details of geometry are essential to model, and how these will influence the results if some of the details are ignored in the modeling.

Sometimes, there is a complex geometry with many details in engineering problems, and modeling of complex geometry is difficult and time consuming. Furthermore, if there is a lot of a detail in the input to the FDS simulation, the simulation time is increased and powerful computers are needed. Especially when high accuracy answers are considered, the grid sizes must be fine and the calculation time is increased even more. For these reasons, in order to find easy and fast results, it is common practice to choose a simplified simulation without enough knowledge of how these effects the results from FDS, and how valid the results are.

In most cases, it is not possible to do real experiments so results from FDS are the base for judgment of fire resistance and level of safety in new and old designs. Therefore, results from FDS have played a vital role to engineering approach and research but further research to find answers of these questions are needed.

1.1 Objective of this thesis

Nowadays, the standard ISO full-scale room test for surface products (ISO 9705) [1] is used in test of materials and fire scenarios in many countries in the world (especially in Europe). The 1/2 scale model of the ISO room corner test (ISO 9705) is chosen in this study. There are sophisticated geometries and many details such as ventilation system, hood, duct, platform in the 1/2 scale ISO room. Complex geometry and ventilation has played a key role to simulation and effect on validation of results in a laboratory environment, but is often neglected in simulation by simple modeling.

Nevertheless, lack of enough information about the effect on simulation in FDS and the results is a problem. The layout of the surroundings, such as hood, platform, duct system, and constructions outside the enclosure, might influence the flow pattern of combustion gases from an enclosure fire when conducted in laboratory environment. There is a lack of information in this area related to computational models and experimental uncertainties.

The main objective of this study is to investigate how complex FDS simulations are needed in order to serve as validation of room tests performed in a laboratory environment. The accuracy of FDS predictions for complex geometries and ventilation in the ½ scale ISO room are investigated in this research. The comparison between FDS predictions of different models with experimental data from two experimental set-ups are also performed and presented in this study.

In the study presented here, validation has been done by comparison with experimental data, which have been provided from experiments in one part of the course ''Advance fire dynamics''. The results of modeling in FDS were compared with these experimental results.

1.2 Previous studies

In this part, some relevant previous studies are presented. Most of the previous studies presented in literature have been made with focus on the validation of FDS and investigating the accuracy of FDS such as results with different grid sizes and fire situations. Before surveying previous studies, a definition of validation and verification is required.

1.2.1 Validation

Validation is a key issue when judging the usefulness of a computer model such as FDS. There are many definitions but one useful can be found in the FDS Technical Reference Guide, which says that a process to define the suitable governing equations in a mathematical model of physical phenomena is named validation. Generally and briefly, validation is the comparison between results of a model with experimental measurements [2].

CFD (Computational Fluid Dynamics) models (e.g. FDS) are one of the most complex tools accessible to researchers and engineers who work in fire safety field. The fundamental laws of physics rather than empirical correlations are the base of these models. Therefore, CFD models offer the best available and versatile approach to solving fire dynamics problems. Although, according to their complex nature, they require expert knowledge from the user [3].

1.2.2 Verification

There are many ways for verification of CFD modeling and many researchers have published articles on this. One thorough survey has been published by W.K. Mok and W.K. Chow [4], who have presented six ways and methods for checking the completeness of technical documentations:

- Independent expert can check it
- Compare with analytical solution
- Benchmark fire code comparison
- Grid size and time step refinement exercise
- Monitoring the residual error of governing equations
- Validation with experimental results

1.2.3 Review of literature

This section will present some previous studies about validation of FDS and investigation of FDS accuracy in different situations. As discussed before, one important question in CFD is about the model credibility. Many researchers have done studies on validation of the FDS model, some of them are presented briefly below.

The accuracy of FDS has been studied by Piotr Smardz [5]. He has investigated comparison between experimental values and FDS predictions. The assessment of predictive capabilities of

FDS was made in the context of the statement made by the authors of the program, that it can predict flow velocities and temperatures to an accuracy of 5 to 20% for simulations that involve simple mass and heat transfer.

In the study by Piotr Smardz, the results of small-scale physical experiments were compared with the FDS predictions. The main parameters for which assessment were made include temperatures in the fire compartment and in the smoke reservoir and the height of the smoke layer in the reservoir. The influences of different mesh types were also investigated. This study confirms the observations made earlier by other authors that the resolution of the numerical grid is critical for accurate results. Where a coarse mesh was used, FDS predictions were in certain cases found to differ from the experimental results by more than 20% [5]. It should be noted that the simulations were made on simple geometry and that he did not model any ventilation system or duct. Only a simple room with different grids were considered.

Another previous study has been done by Harrison who has worked on validation in research on spill plume [6]. He used physical scale modeling and FDS to investigate factors that effects air entrainment into spill plumes. A 1/10 th physical scale model with the dimensions 1m by 1m by 0.5 m height was used in the experimental part for ethanol pools. Temperature profile at the compartment opening, temperature profile at the spill edge, velocity profile at the compartment opening, and velocity profile at the spill edge were investigated. The results were compared to FDS predictions. As brief conclusion, his work showed that temperature profiles were described as “good to excellent” and velocity was described as ‘good’. As in the previous study by Piotr Smardz, only simple modeling was considered in this study, moreover; complex geometries and ventilations such as hood, etc were ignored in the simulations.

The U.S. Nuclear Regulatory Commission and Electric Power Research Institute (EPRI) have done research on verification and validation for nuclear power plants [7]. The purpose of this study was to predict the risk in fire scenarios for some parts of the power plant such as switchgear room and main control room. Guidelines from ASTM (the American Society for Testing and Materials) [8] was used as methodology description and twelve scenarios were selected in this research and for three of them full–scale tests were done and the experimental data were compared with FDS simulations. The results from FDS are organized under titles given below:

- Hot Gas Layer Temperature /Height
- Ceiling Jet Temperature
- Plume Temperature
- Flame Height
- Smoke /Oxygen /CO2 Concentration
- Room Pressure
- Radiation Heat Flux
- Surface Temperature /Wall Heat Flux

As brief conclusion and summary, heat release rate and surface temperatures are predicted with 25% accuracy, also room pressure and gas temperature are predicted with 15% accuracy [7].

In addition, work on validation can be found in the FDS technical reference guide [9], where it is divided into the following categories:

Comparison with engineering correlations; Comparison with full-scale experiment; Comparison with standard test; Comparison with previously published full scale experiments, Comparison with documented fire experiments [2],[9]. Although it is very concise some examples from fire models were validated and compared with each other.

1.3 Outline of thesis

The research will be divided into nine sections including the introduction and objectives. A brief background section is given about previous research especially in the area of validation and verification.

The second chapter will cover methodology and is divided in two parts; the first part explains the experimental set up and some theories; the second part of this chapter will introduce the FDS simulation set up with different geometries, mesh sizes, boundary conditions, etc.

The third chapter will present results of experiments and FDS simulations. The fourth chapter will cover discussion about results as well as investigation of results. The conclusion of this thesis will be presented in chapter five. Suggestions for further work are expressed in chapter six. The acknowledgements will be given in chapter seven. The references will be given in chapter eight and in chapter nine the appendix is included.

2 Methodology

The following section includes a description of the experimental setup and FDS simulation setup. The method of research involves two parts: one part about experiments in the 1/2 scale ISO room and how the experiments are setup, and the theory and equations of the oxygen consumption technique. The second part includes the FDS set up and five models with different steps that have an increasing complexity in geometry. This part presents a description of Computational Fluid Dynamics, fire scenario, geometry, properties of materials, mesh size, boundary of simulation and sensitivity analysis.

In order to avoid duplication of experiments, data from experiments performed in the course 'advanced fire dynamics (VBRN05)' have been used. Simulations with these data were done in the course 'Simulation of fires in enclosures (VBRN15)'. These simulations were done on just the simple room with moderate mesh size and with a run time of 400 seconds .The purpose was just to understand the behavior of the fire inside the enclosure. It should be noted that in the research presented here, experimental data are used only as comparison with different FDS simulations and validation of the modeling, in order to demonstrate the effect of ventilation and complex geometry in a laboratory environment. The experimental setup in the laboratory is explained in the following section.

2.1 Description of experimental part

This part will explain the experimental framework. Data from two experiments are chosen from the four experiments that were done, for both of them Heptane was used as fuel.

The experiments were performed in the 1/2 scale model of the ISO room corner test (ISO 9705) in the laboratory environment. Figure 1 shows the layout of the 1/2 scale ISO room.

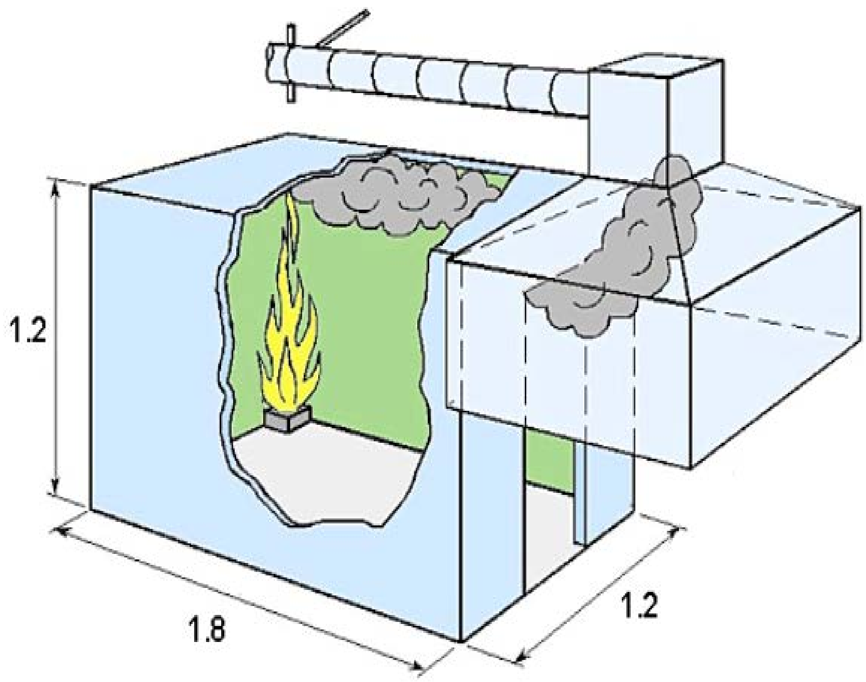

Figure 1- schematic of laboratory set up [11]

Figure 2-Picture of laboratory and 1/2 scale ISO room

2.1.1 Equipment device:

The experimental equipment presented below was used in the laboratory environment. It should be mentioned that only data from some of them were used in the simulations of the experiments.

- A thermocouple tree was located in the middle of the door opening, 10 thermocouples with height differences of 10cm and height of the first thermocouple h_0=26cm;
- A thermocouple tree was located inside the enclosure, 20 thermocouples with height differences of 5cm and height of h_o=26cm;
- A bi–directional probe and thermocouple inside the exhaust duct;
- A circular fuel tray with D=20cm;
- A radiometer, near the opening at the height of 26cm, pointed towards flame;
- A heat flux meter, inside the enclosure pointed towards the smoke layer;
- Gas analyzer for O_2 connected to exhaust duct;

- Ruler (for determining smoke layer height);
- Smoke matches (for determining neutral layer height).

2.1.2 Experimental scenario and set up

As is mentioned before, a fuel tray with Heptane placed in the middle of room was chosen as fire source. The pictures below, Figures 2-7, show different parts of the experimental set up.

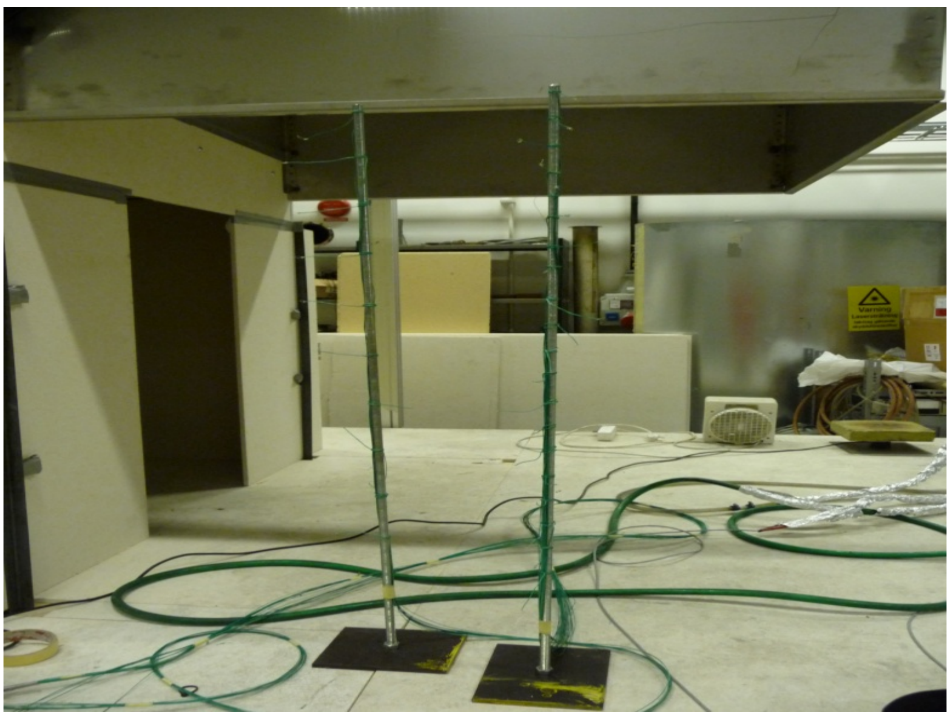

Figure 3-installation of experimental equipment, thermocouple trees

Figure 4-The room before installation and set up experimental equipment

Figure 5- The room after installation and set up experimental equipment

Figure 6- Installation of experimental equipment, Radiometer pointing towards the flame

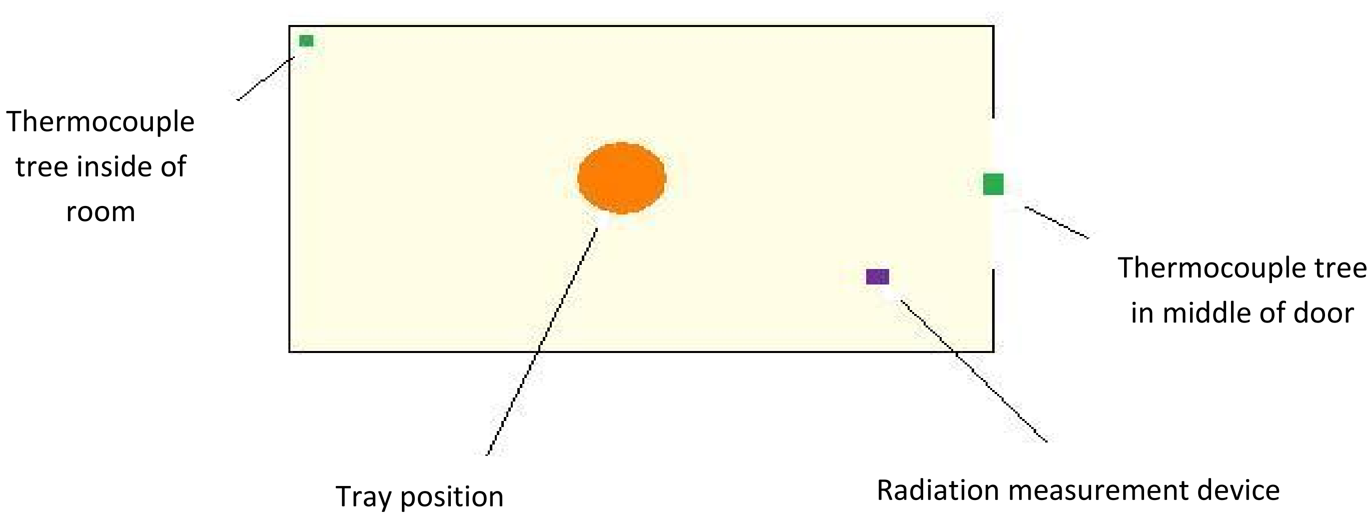

Figure 7- Position of equipment in the experiment

The first experiment was done with Heptane measuring for 15 minutes; in order to perform a sensitivity analysis this experiment was repeated with another heat release rate (see table 1). This experiment was carried out for 14 minutes. Figure 8 shows a photo from the experiment.

Figure 8-During the experiment

Temperatures in the hot layer, concentration of oxygen in the duct and weight of the pool fire (mass loss) were measured. The Oxygen Depletion Theory was used for the HRR (Heat Release Rate) calculations. Data for these calculations were taken from measurements in the extraction hood, oxygen concentration, temperature and pressure differences [10]. It is important to notice that the HRR calculated from the experimental data will be an average for the steady state period of the fully developed fire.

Experiment	HRR Experiment (KW)
Experiment 1 -Heptane in middle of room	26.43
Experiment 2- Heptane in middle of room	27.19

Table 1- Heat Release Rate from experiments

2.2 Theory

The Heat Release Rate (HRR) is calculated by using the formula below. This formula is obtained from a paper by Janssens on the measuring rate of heat release by oxygen consumption [12]:

$$\dot{q} = E\frac{\phi}{1+\phi(\alpha-1)}\dot{m}_e\frac{M_{O2}}{M_a}(1-X_{H2O}^{0})X_{O_2}^{A^0}$$ **Equation 1**

Where:

$$\phi = \frac{\dot{m}_{O_2}^{0}-\dot{m}_{O_2}}{\dot{m}_{O_2}} = \frac{X_{O_2}^{A^0}-X_{O_2}^{A}}{(1-X_{O_2}^{A})X_{O_2}^{A^0}}$$ **Equation 2**

$$\dot{m}_e = (1-\phi)\,\dot{m}_a + \alpha\phi\,\dot{m}_a$$ **Equation 3**

The formula above is valid with the assumptions:

- Gas and air only consists of O_2, water vapor, and N_2, all small fractions are lumped into nitrogen

$\dot{q}$ – Rate of heat release(kW);

E – Heat released per unit mass of O_2 consumed($13.1\ MJ.kg^{-1}$ of O_2);

$\emptyset$ – Oxygen depletion factor;

α – Combustion expansion factor;

M_{O_2} – Molecular weight of O_2($\approx 32kg.kmol^{-1}$);

M_a – Molecular weight of the incoming air ($kg.kmol^{-1}$);

$X_{O_2}^{A^0}$ – Measured molar fraction of O_2 in the incoming air;

$X_{O_2}^{A}$ – Measured molar fraction of O_2 in the exhaust;

$X^{o}_{H_2o}$ − Mole fraction of H_2O in the incoming air;

$\dot{m}_a$ − Mass flow rate of the incoming air ($kg.s^{-1}$);

r_0 − Oxygen mass to fuel mass;

m_{O_2} − Oxygen mass ;

The E – Factor is heat released (per mass) of oxygen consumed. Common assumption is that this factor is the same for almost all fuels (13,1kJ/g). If the E factor was calculated for the appropriate fuel that is planned to be used in the experiment, it would increase the validity of the results.

2.2.1 Calculation of E factor and expansion factor:

The combustion equation for Heptane fuel is showed below [13]:

C_7H_{16} + 11 O_2+ 40.9 N_2→ 7CO_2 + 8H_2O + 40.9 N_2 Equation 4

The α is defined by

$$\alpha = \frac{n_{products}}{n_{reactants}} = 1.08$$ Equation 5

$$E = \frac{\Delta H_c}{r_0}$$ Equation 6

$$r_0 = \frac{m_{o2}}{m_{fuel}}$$ Equation 7

$$m_{O_2} = M * n = 32 * 11 = 352\ g$$ Equation 8

$$m_{C7H16} = M * n = 100 * 1 = 100g$$ Equation 9

$$r_0 = \frac{m_{O_2}}{m_{fuel}} = \frac{325}{100} = 3{,}25$$ Equation 10

$$E = \frac{\Delta H_c}{r_0} = \frac{44.6}{3{,}25} = 13{,}7(MJ.kg^{-1}\ of\ O_2\ )$$ Equation 11

2.3 Computational fluid dynamics (CFD)

In this section, a brief explanation about CFD (Computational Fluid Dynamics) and the FDS code will be given and some information about the simulations of the laboratory experiments are also presented along with more details about how the simulations are done.

Nowadays, few engineer and designers can be found who do not use useful tools like CFD. The CFD codes are powerful tools that can be used for predicting the behavior of a fluid in a flow field of interest, heat and mass transfer, phase change, chemical reaction (for example combustion), mechanical movement (for example, fan or piston) and even the stresses or deformation of related solid structures. The CFD codes have been available since 1940s. During the years, many modifications and improvements have been done. Consequently, better and faster development of codes will lead to shorter design cycles and will compress the time between the conceptual stage and field implementation [13].

The CFD Modeling process includes these steps: Physical scenario, Geometry, Computational Mesh, Governing equation, Physical Model, Solution Algorithm, Boundary Condition, Obtain solution and analysis of them [14].

2.3.1 Fire Dynamics Simulator (FDS)

There are a number of CFD codes in fire engineering applications such as FDS (using Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS)), KOBRA-3D, Sofie, Jasmine, Smart-fires (using Reynolds Average Numerical Simulation (RANS)). FDS is a popular tool for researchers and fire safety engineers. The simulation is done based on solving the Navier-Stokes equation [15].

In this category of programs (codes), only FDS uses a LES model for simulation. FORTRAN is the main computer program that was used in the 1990s, and the first version of FDS was published in February 2000. After this, numerous improvements were done on the software. The FDS is written based on fundamentals of combustion and fire dynamics. The governing equation rectilinear gird is used by FDS, moreover; mixture fraction model is used as combustion model in FDS. Nowadays, the FDS is one of the favorite tools for fire safety engineers and researchers to investigate fire behavior because it has a suitable tool to show results such as smoke view.

In this study, FDS is used a code for simulation of fire behavior. Furthermore, five steps are simulated in order to predict how a complex geometry effects the results. The step by step model is rather sophisticated and will be explained in the modeling and geometry part of the report.

2.3.2 Fire Scenario

To facilitate the comparison, the fire scenarios in FDS are chosen similar to the experimental set up, fuel is heptane (C_7H_{16}) and it is placed the middle of the ½ scale ISO room. The time of running in experiment 1 has been set to 900 seconds and for experiment 2 it is 850 seconds. Moreover, the initial temperature is considered to be 16˚C (exactly as in the experiments).

2.3.3 Modeling & Geometry

In order to understand the effect of geometry on the results, five model simulations are established in this work and more details are added from the first modeling to the last modeling step by step.

It should be noted that due to the fact that FDS has limitations on modeling a curve or circle shape, rectangular grids must be chosen. For example in the experiments, the tray of fuel was cylindrical but is simulated as cubic ;moreover, the duct has a circle section but in FDS is simulated as a cube with the same area as the circular section.

2.3.3.1 First Model:

In the first set of modeling, only the 1/2 scale ISO room is used in the simulation of fire, hood, duct, other ventilation and platform are not considered here. Indeed this model is of a simple geometry and boundary. (This model is named ''1-room'' in simulation in this study), figure 9 shows this model.

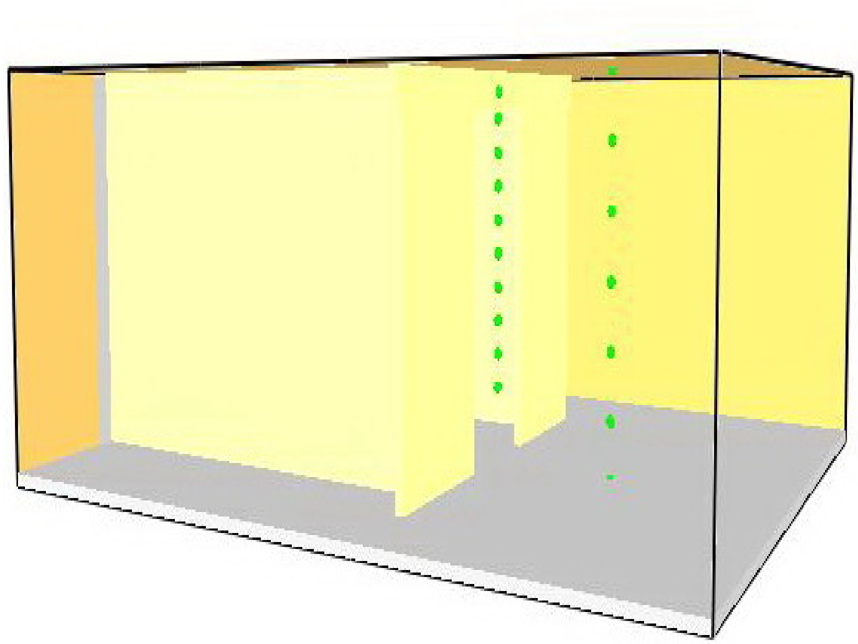

Figure 9-The first model ''1-Room''

2.3.3.2 Second model:

The second model, hood and duct systems are added to the first model in order to investigate the effect of hood and duct for smoke exhaust (‘‘2-hood’’ name is chosen for this model), figure 10 shows this model.

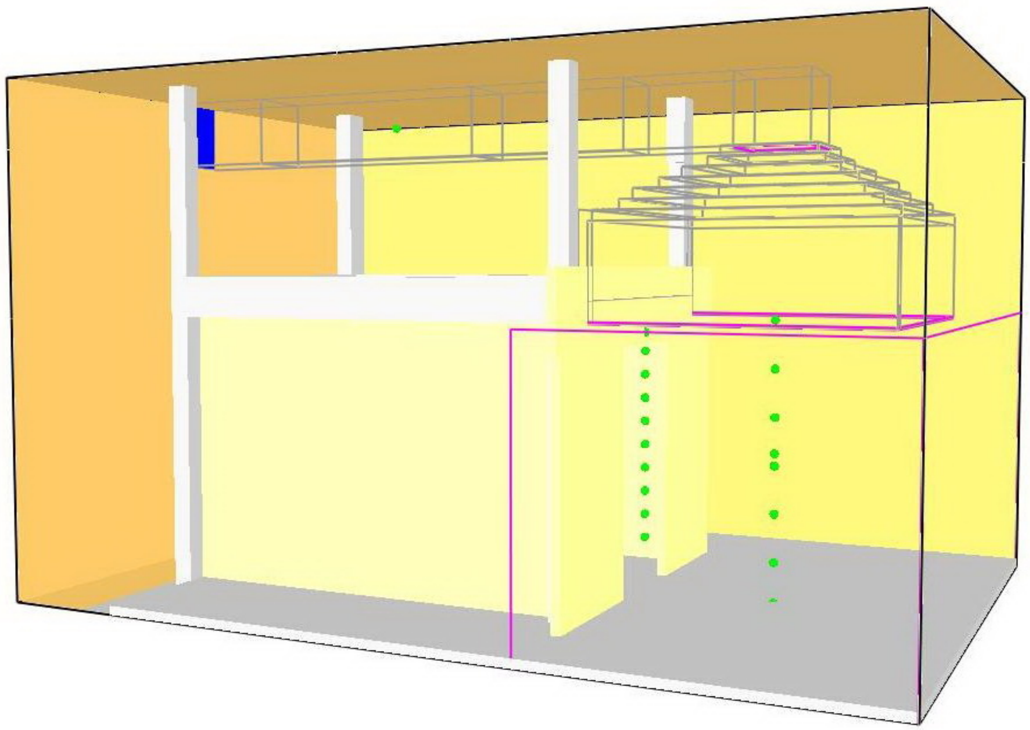

Figure 10-The second model ‘‘2-hood’’

2.3.3.3 Third model

The third set of geometry is used to investigate effect of air supplier (air entrance from outside of laboratory), so now the air supplier is added to the second model (‘‘3-hood-air’’ is the name for this model in this research), figure 11 shows this model.

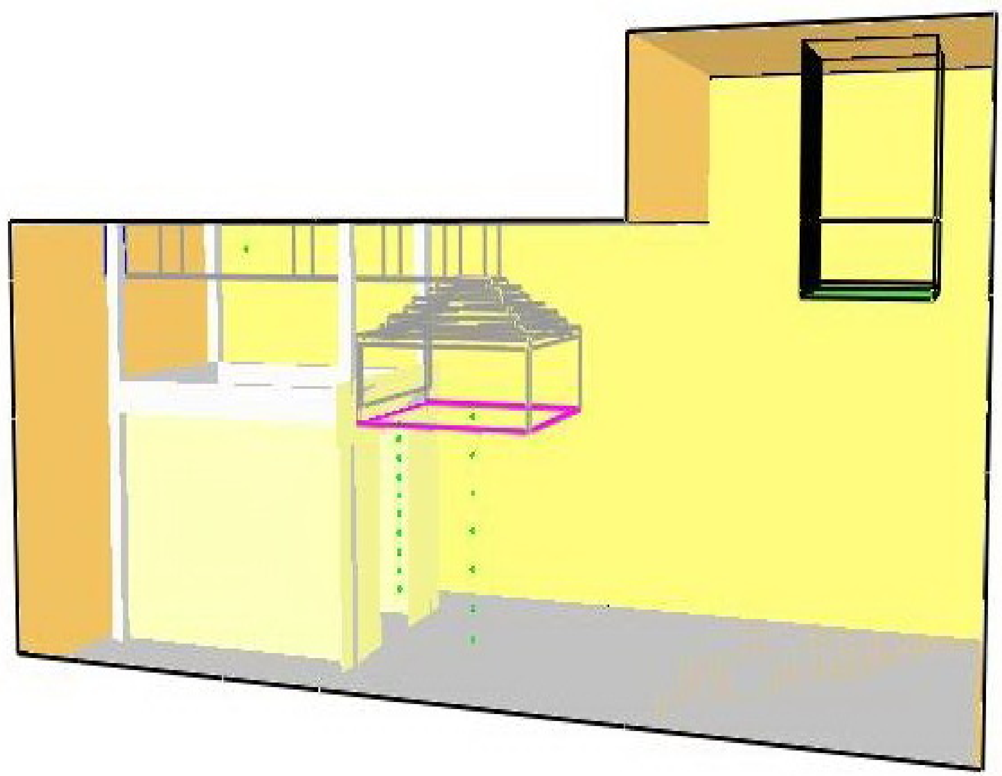

Figure 11 –The third model ‘‘3-hood-air’’

2.3.3.4 Fourth model

The fourth model is a complete geometry corresponding to the reality in the laboratory. In this model, platform with a height of 70cm is added to the third model (''4-platform'' name is chosen a this model), figure 12 shows this model.

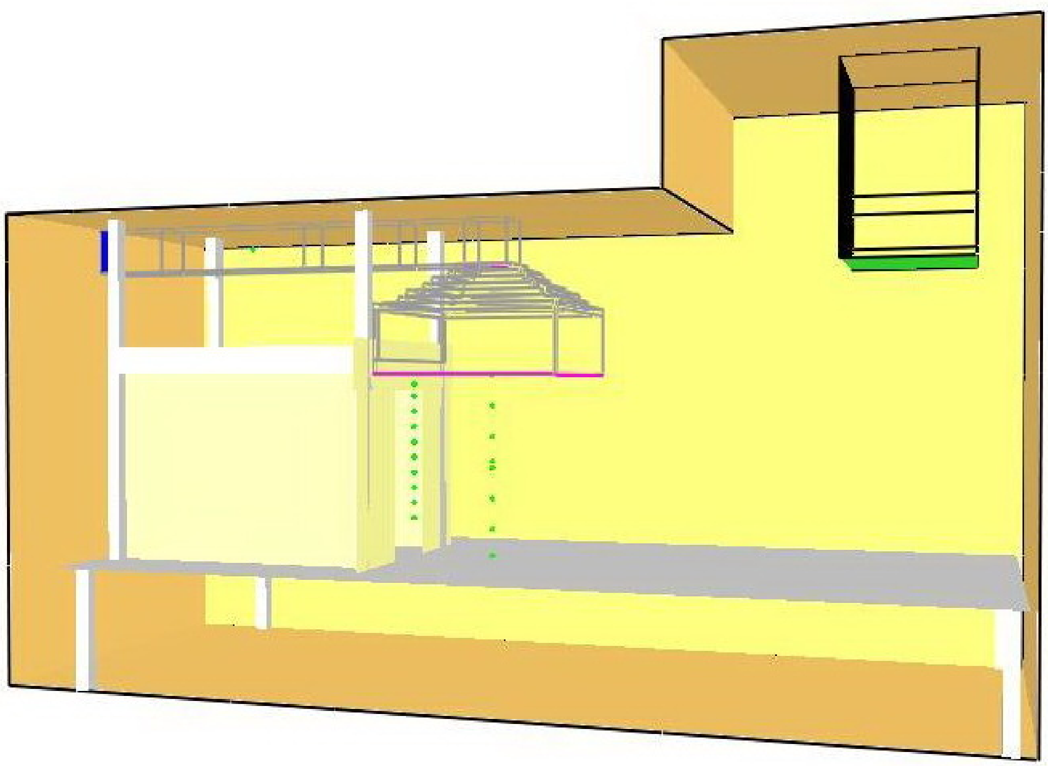

Figure 12 –The fourth model ''4-platform''

2.3.3.5 Fifth model:

In the fifth model the effect of shortening the platform, according to layout in figure 13 is investigated. (This model is named ‘‘5-platform-S’’ in FDS simulation.)

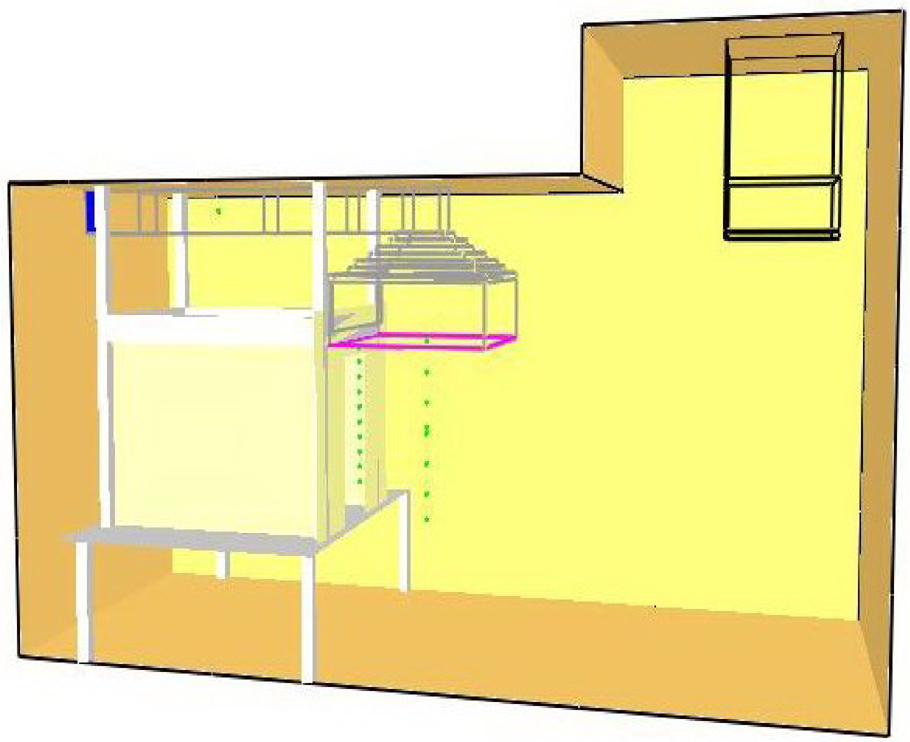

Figure 13-fifth model ‘‘5-platform-S’’

2.3.4 Properties of material

In this study, the material properties of the simulated materials correspond to the materials in the laboratory such as Promatect–H in the inner layer of the compartment walls. In table 2 below the properties of Promatect–H are shown[16].

Promatect –H	properties
Density	$870 \frac{kg}{m^3}$
Specific Heat	$0.92 \frac{kJ}{(kg.K)}$
Emissivity	0.9
Absorption	5.0 E4 1/m

Table 2-Properties of material in FDS simulation

Similarly, steel with thickness 0.002 m is simulated as material for burner and steel plate in hood, duct, and air supplier. In table 3 below, the details of properties for steel used in FDS simulation are presented[17].

Steel	properties
Density	$7850 \frac{kg}{m^3}$
Specific Heat	$0.46 \frac{kJ}{(kg.K)}$
Emissivity	0.95
Absorption	5.0 E4 1/m

Table 3-Properties of material in FDS simulation

Furthermore, in table 4 below, the details of the fuel are presented[18].

Heptane(C_7H_{16})	properties
Heat of combustion	$44.59 \times 10^6 \frac{J}{kg}$
Density	$684 \frac{kg}{m^3}$

Table 4- Properties of fuel (heptane)

2.3.5 External boundary condition

All solid surfaces are assigned thermal boundary conditions, plus information about the burning behavior of the material. Heat and mass transfer to and from solid surfaces are usually handled with empirical correlations [19].

The ‘‘exhaust’’ in the simulation is assigned to the external boundary conditions of the hood and duct as smoke exhaustion. The velocity in the hood entrance was measured in the laboratory; moreover, ‘‘entrance’’ is defined in the simulation as a ‘‘supply’’ of fresh air provided from the outside of the laboratory. It should be noted that the time of starting for the hood and air supplier in the simulations have been set to 1 second (approximately, immediately after starting experiment). Furthermore, the ‘‘Open’’ boundary in FDS modeling is defined as boundary condition within this domain. ‘‘Burner’’ is described as heptane fuel where the Heat Release per Area (HRRPUA) for the experiment 1 (see table 1) is given below:

$$HRRPUA = \frac{HRR\ experiment\ 1}{Area\ of\ Burner} = \frac{26.43}{\pi \times \frac{0.2^2}{4}} = 841.29\ {}^{kW}/_{m^2}$$ Equation 12

This value for experiment 2 is

$$HRRPUA = \frac{HRR\ experiment\ 2}{Area\ of\ Burner} = \frac{27.19}{\pi \times \frac{0.2^2}{4}} = 928.5\ {}^{kW}/_{m^2}$$ Equation 13

Starting time for ‘‘Burner’’ in the simulation is set to 30 seconds after ignition of the heptane (correspond to experiments were done in reality).

2.3.6 Mesh Size

A mesh is a single right parallelepiped, for example a box. The coordinate system within a mesh conforms to the right hand rule. It should be noted that it is best if the mesh cells resemble cubes, that is, the length, width, and height of the cells ought to be roughly the same. Because an important part of the calculation uses a Poisson solver based on Fast Fourier Transforms (FFTs) in the y and z directions, the second and third dimensions of the mesh should each be of the form $2^l 3^m 5^n$ where l, m, and n are integers [20].

However, FDS has the ability to solve Direct Numerical Simulation (DNS), it should be mentioned that existing computers do not have ability to solve DNS for large dimensions, for these reasons fire protection engineers and researchers have to use LES models. In this research, according to dimensions, the LES model has to been chosen. It should be noted that very fine mesh sizes are simulated only in the first model (‘’1-room’’), in order to compare the effect of mesh sizes on results that will discussed later. Therefore, it is significant to choose optimal size for the mesh.

In order to find the best mesh resolution, it is necessary to calculate the characteristic fire diameter (D*) [21], that is given by

$$\mathbf{D}^* = \left(\frac{\dot{Q}}{\rho_\infty C_P T_\infty \sqrt{g}}\right)^{\frac{2}{5}} \qquad \text{Equation 14}$$

The nominal size of a mesh cell is δx [21], where it is said that “for simulations of buoyant plumes, a measure of how well the flow field is resolved is given by the non dimensional expression D*/ δx”.

It should be noted that these values are used to sufficiently resolve the plume dynamics, along with other geometrical characteristics of the models as well. This range does not show what values have to be used for all models, only what values worked well for that particular set of models [22].

There is another method to find mesh size, which has been confirmed by Merci’s study in which the value of 0.1D* is used [23]. Furthermore, ‘’Koverholt’’ website [24] can be used to estimate a preliminary size of meshes.

In this study, elementary estimate for size of mesh is done by the ‘’Koverholt’’ website [24]. The other methods are used to find optimal grids (grid size in some parts: 0.04 m*0.04m*0.04m). In order to get good results, meshes are chosen unequal.

2.3.7 Sensitivity Analysis in Simulation

In this work, several simulations are conducted to evaluate FDS. Firstly, experiment one is simulated for the five models that have been explained before. Next, all simulations are done for experiment two. In addition coarse meshes are used for all models in experiment 1. Moreover, the first model is simulated with a very fine grid, in order to evaluate the effect of the mesh size on the results. Finally, in order to find the effect of the hood exhaust on the results, the specific volume flux in the input of FDS is decreased approximately 30 % and then all the models are run again for this value. The different runs that are simulated are presented in table 5 below.

Experiment/ FDS modeling	1-room	2-hood	3-hood-air supplier	4- platform	5- platform-s
Experiment 1 with fine meshes	yes	yes	yes	yes	yes
Experiment 1 with coarse meshes	yes	yes	yes	yes	yes
Experiment 2 with fine meshes	yes	yes	yes	yes	yes
Experiment 1 with 30% decreasing hood exhaust with fine meshes	yes	yes	yes	yes	yes
Experiment 1 with very fine meshes	yes	No	No	No	No

Table 5-Simulations in FDS

3 Results

In this section, the results of experiments and FDS simulations will be presented. The results are divided into two parts: the first part covers experimental data; the second part covers the simulations results in FDS.

3.1 Results of experiments

Heat Release Rate (HRR) was measured using the oxygen consumption calorimeter that was explained in section 2.2, the HRR experiment 1 is shown in figure 14 (no mass loss was measured during the experiment).

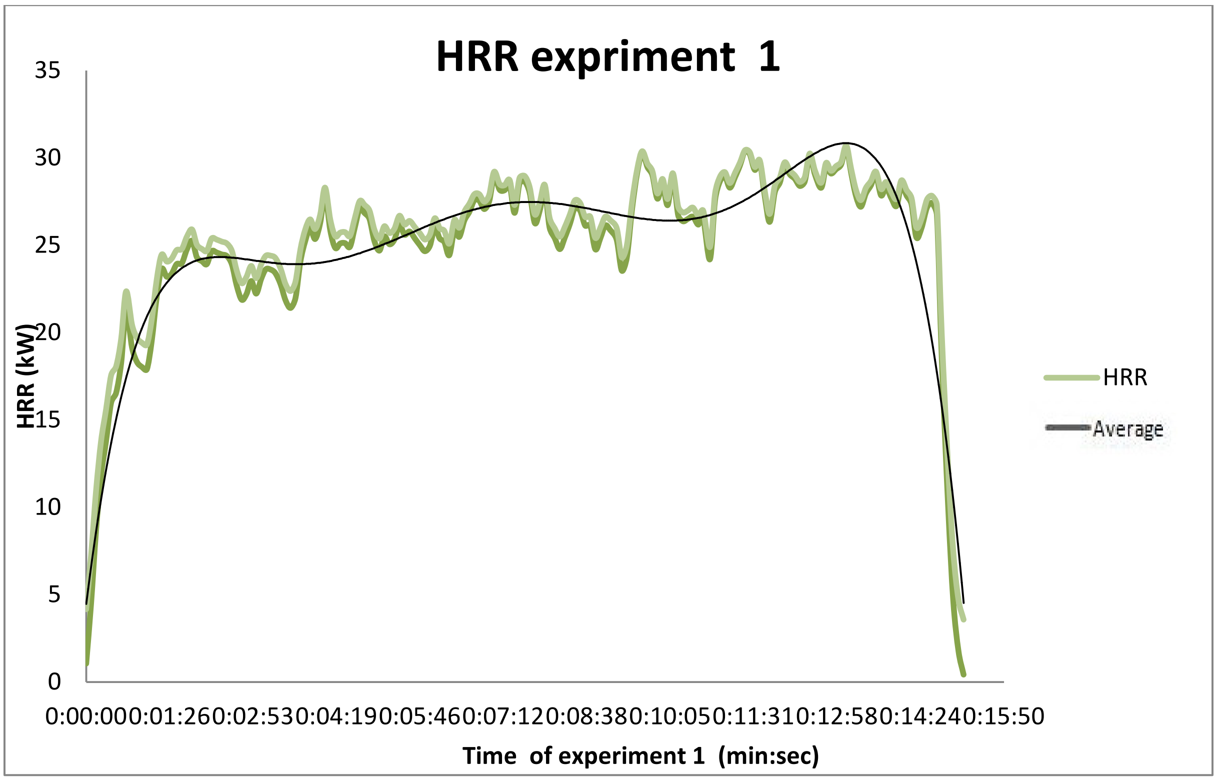

Figure 14-Heat release rate in experiment 1

Figures 15 and 16 present the temperature in the thermocouple trees that were placed in middle of the door opening and inside (corner) the ½ scale ISO room in experiment 1.

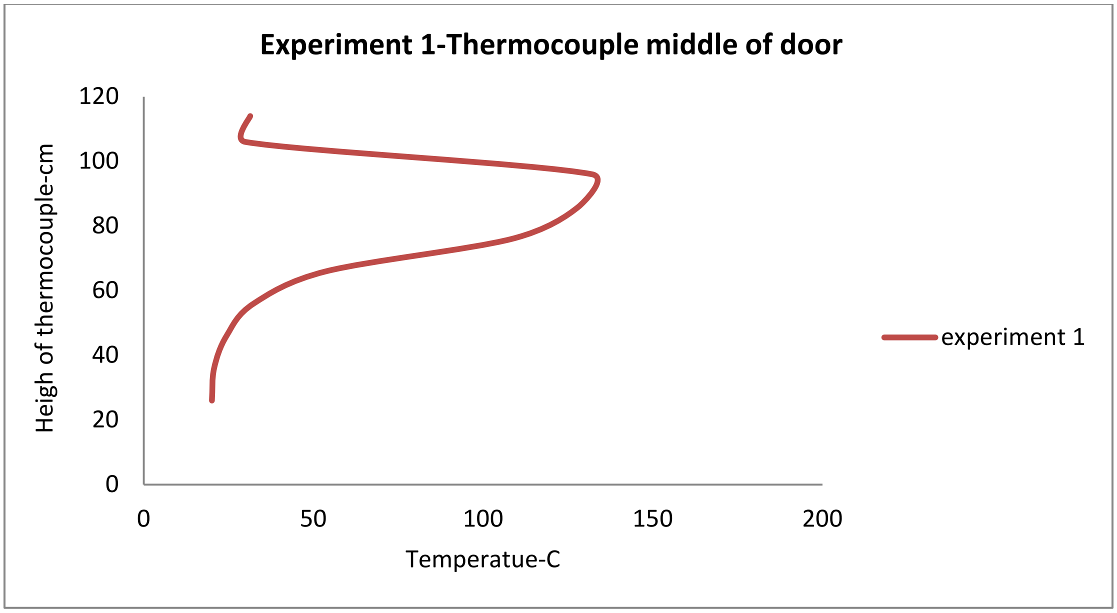

Figure 15-Temperature in thermocouple middle of door (experiment 1)

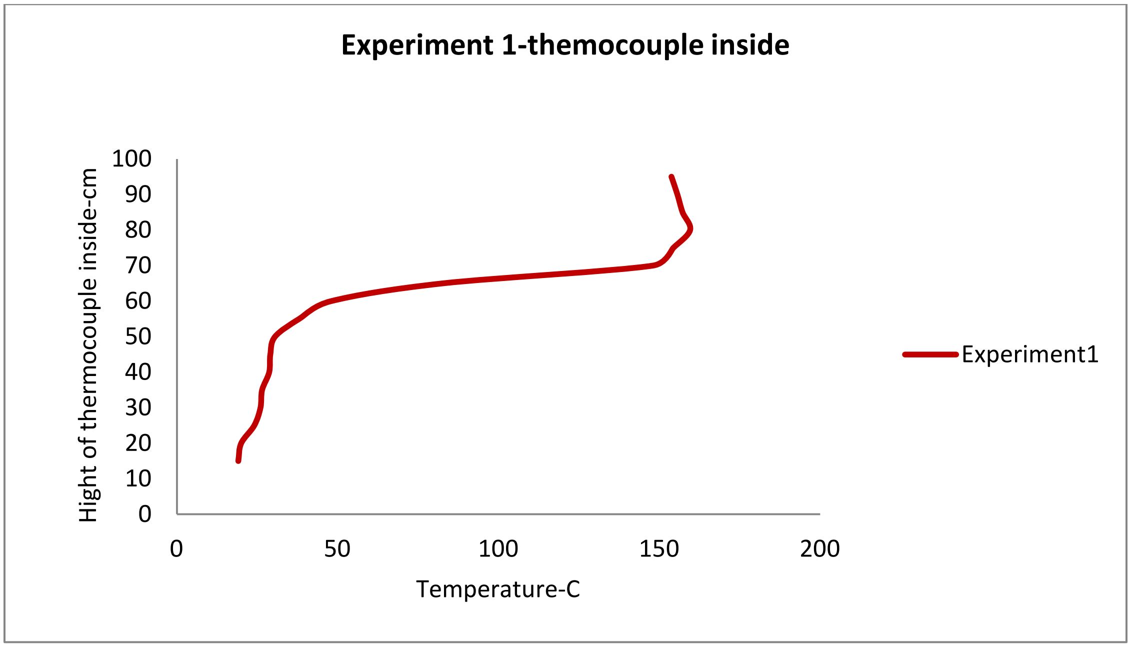

Figure 16 -Temperature in thermocouple inside of room (experiment 1)

Similarly, the results in experiment 2 are shown in the figures 17-19.

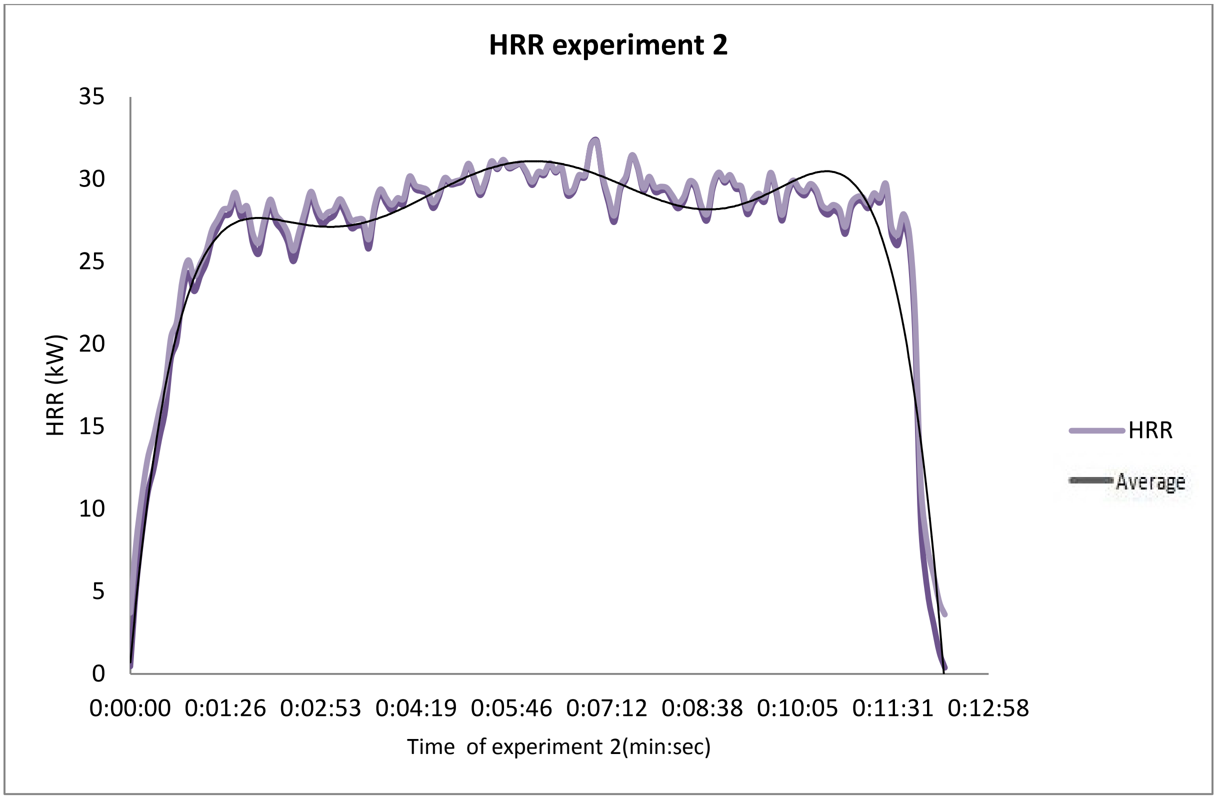

Figure 17-Heat release rate in the experiment 2

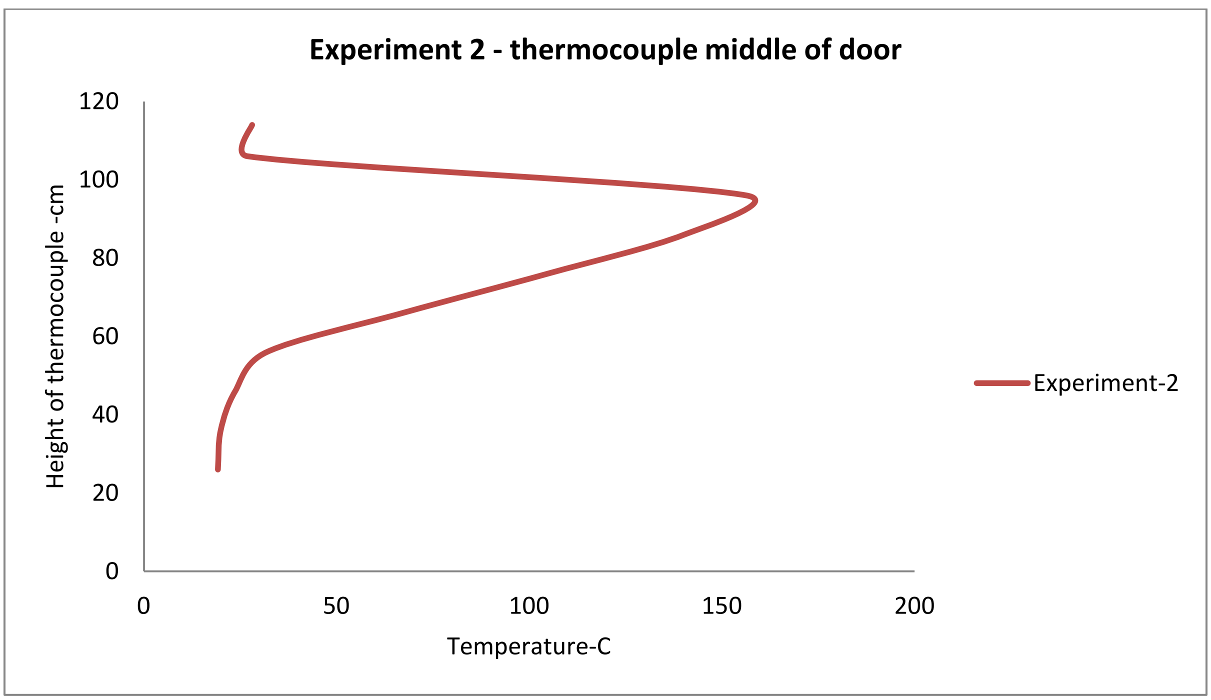

Figure 18-Temperature in thermocouple middle of door (experiment 2)

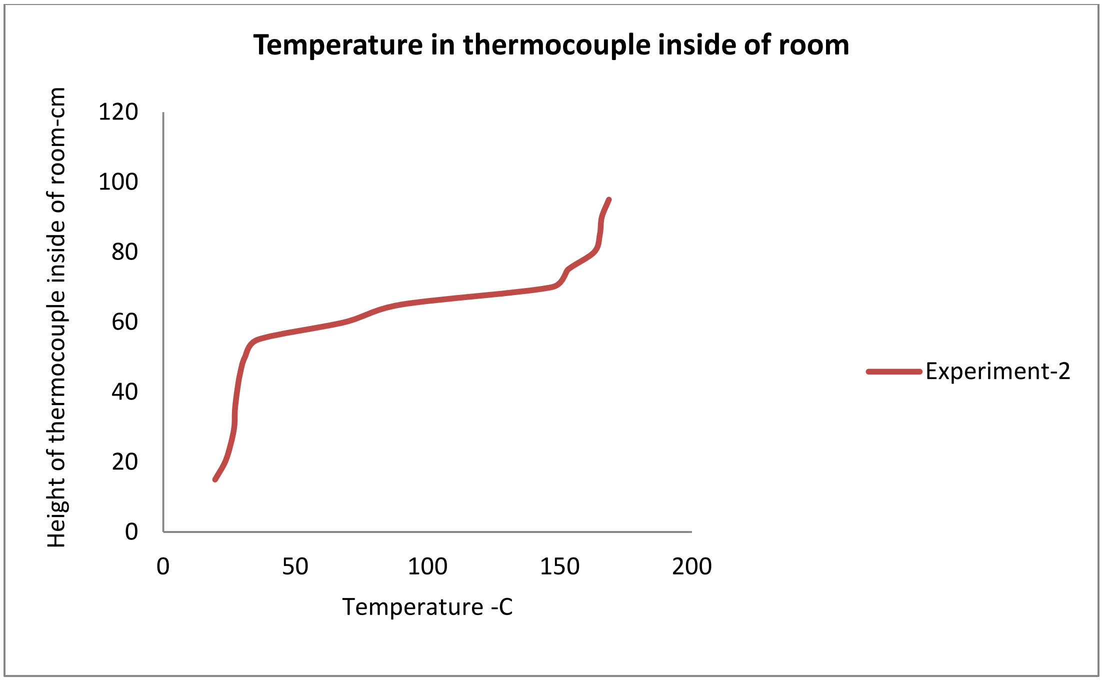

Figure 19-Temperature in thermocouple inside of room (experiment 2)

It should be noted that it was difficult to measure the velocity in the area below the hood during the experiments because there was no device (as a thermocouple tree) to measure velocity at each level. On the other hand, it is hard to give the accuracy of the temperature that was measured because for example the thermocouple tree that was placed inside the ½ scale ISO room was covered with soot. The thickness of the soot has effect on the sensitivity of the thermocouple. The maximum temperature that was measured by the thermocouple tree was decreased because of the soot layer. In the next chapter, the influence of errors in the experiments will be discussed in more detail.

3.2 Results of simulation with FDS

In this section, only the results of FDS are shown, and investigations on the results are presented in the discussion, chapter 4. Prediction of temperatures measured at the thermocouple trees that were placed in the middle door and inside the ½ scale ISO room, and velocities are parameters that are presented as the results from FDS. In order to simplify the comparison between the experiments and the FDS results, the temperatures are calculated as average values. It should be noted that time taken approximately between 400 seconds and 600 seconds in the simulation results are considered as time of steady state. Figures 20 -22 present the temperature profiles in experiment 1.

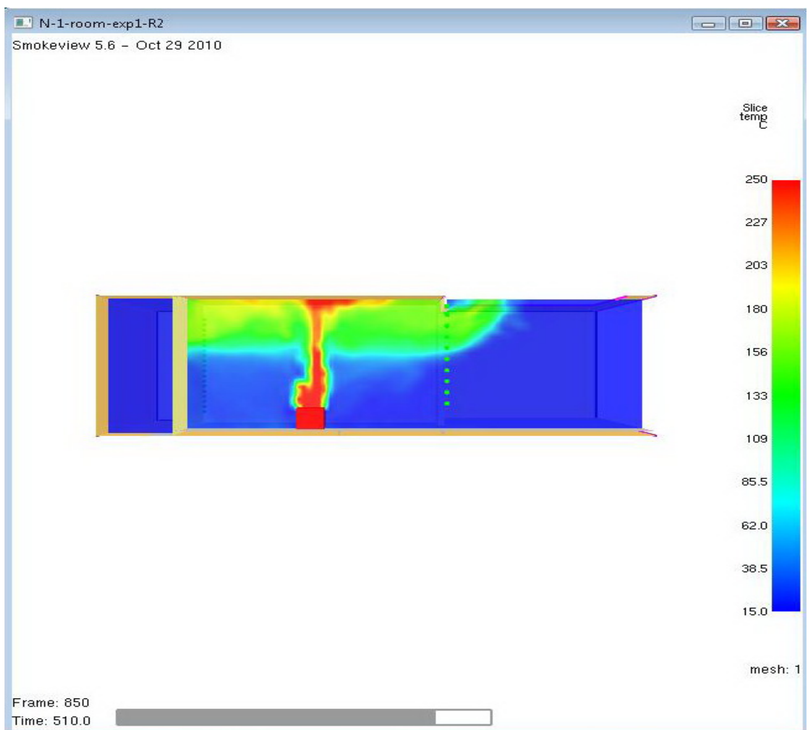

Figure 20-Temperature profile in model ''1-room''

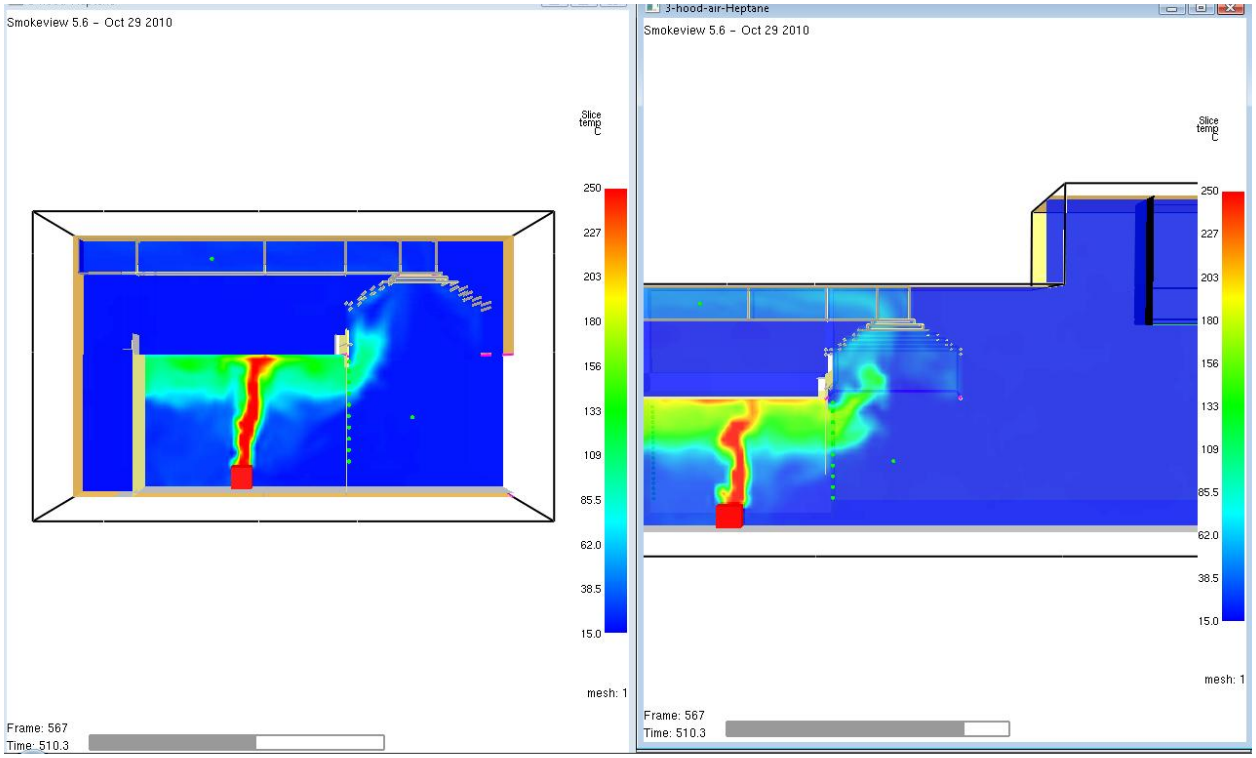

Figure 21- Temperature profiles in model ''2-hood'' and ''3-hood-air''

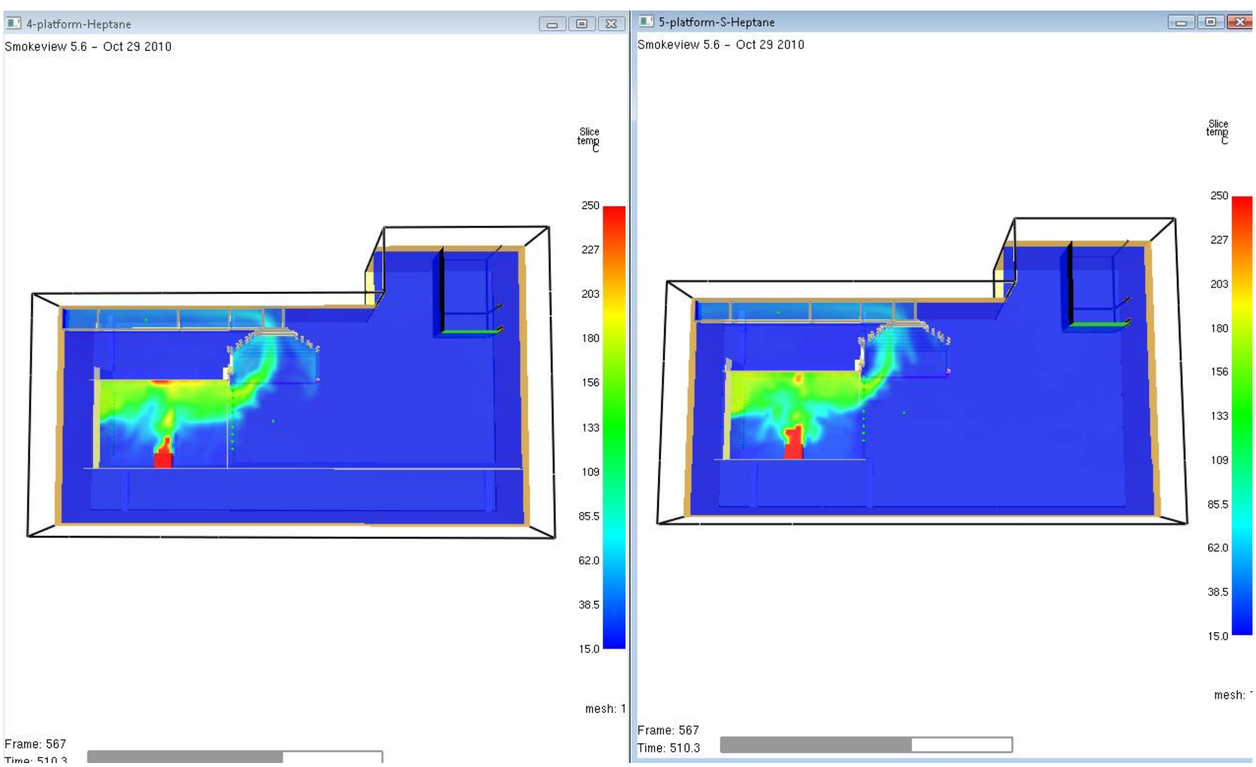

Figure 22 -Temperature profiles in model ''4-platform'' and ''5-platform-S''

It can be seen from the figures 21 and 22, that the temperature profile below the hood has a lower value in the model ‘‘2-hood’’. Furthermore, the highest value for the temperature profile (below the hood) is predicted in the model ‘‘5-platform-S’’. Due to the short platform, more air entrainment has ability to come in to the ½ scale ISO room, so the temperature of the flames will be higher than compared with the long platform. More discussion about the results will be expressed in the next chapter. In addition, the details of the results in the temperature profiles for the others FDS simulations (Including: the experiment 2, the experiment 1 coarse mesh, and the experiment 1 with decreasing hood exhaust) can be found in the Appendix 9.1.

Figure 23 shows the comparison between experiment 1 and all of the FDS simulations with fine meshes.

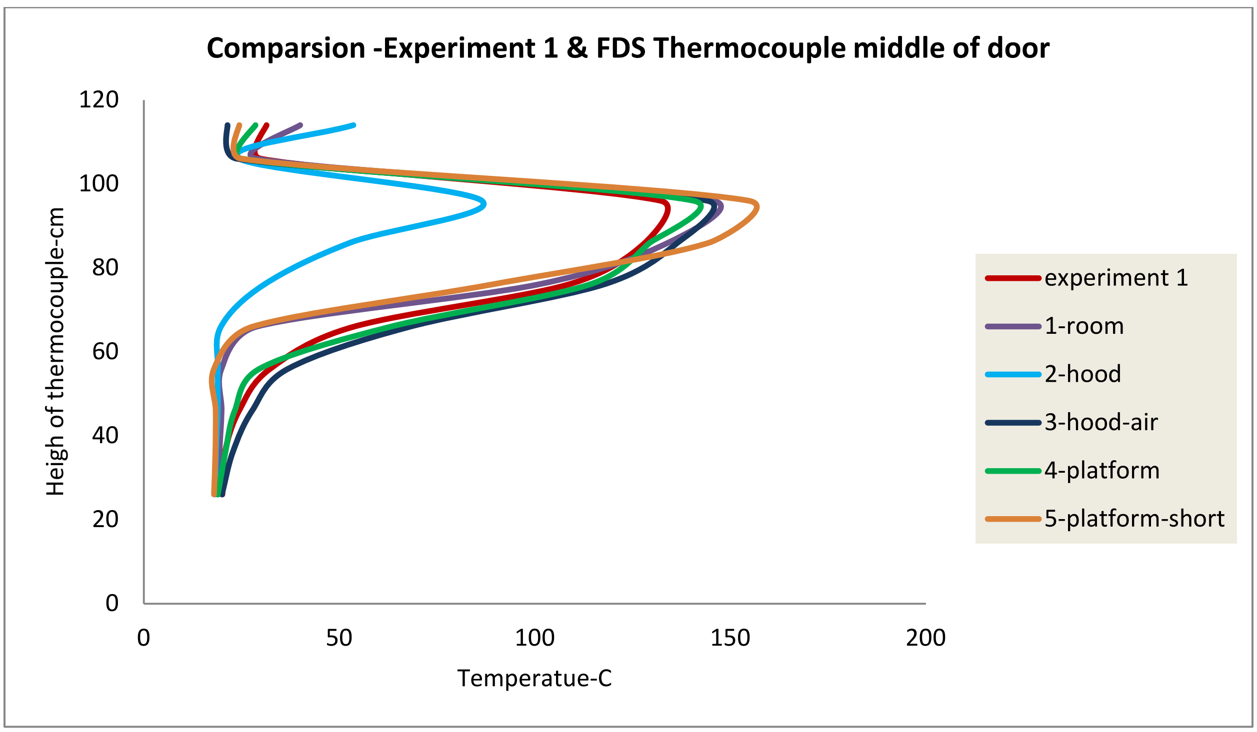

Figure 23 –Comparison experiment 1 and FDS in thermocouple middle of door

Similarly, Figure 24 shows comparison of temperature from the thermocouple tree inside the ½ scale ISO room and FDS simulations for experiment 1.

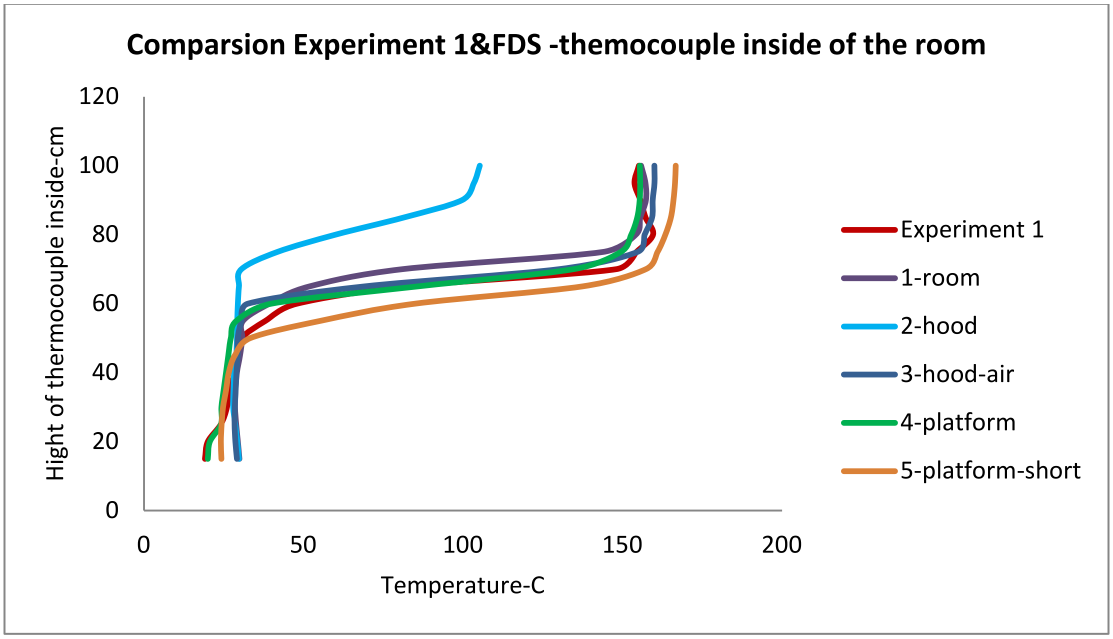

Figure 24–Comparison experiment 1 and FDS in thermocouple inside of room

It can be seen from figures (23 and 24) above that the ‘’2-hood’’ model has the maximum discrepancy with the experimental results; also the minimum error is related to the ‘’4-platform’’ model. Reasons and causes will be explained in the discussion section.

Despite of the fact that the details and complex geometry have effect on the results, the accuracy of FDS is dependent on the size of grids too, so the coarse meshes were simulated for all of the models in FDS too.

Figure 25 shows the comparison between simulations in FDS for coarse and fine meshes (in the fourth model) with experiment 1.

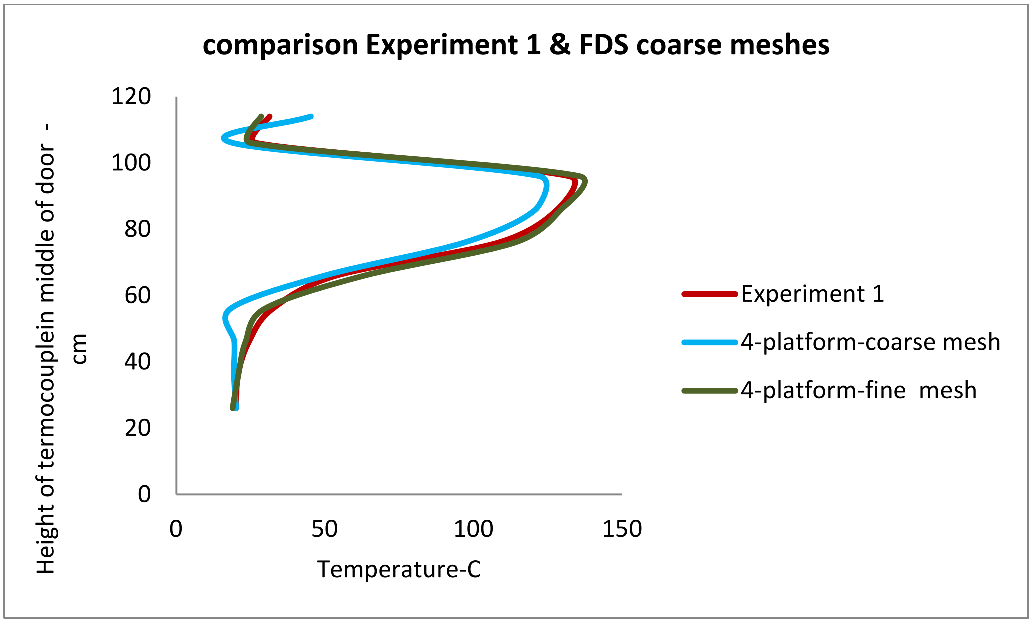

Figure 25–comparison experiment 1 & FDS (coarse meshes) in thermocouple middle of door

The above graph shows that for the results with bigger mesh sizes the errors increased too. In order to investigate how different mesh size (coarse, fine, very fine) can influence the accuracy of the prediction in FDS, model ‘‘1-room’’ was simulated for very fine meshes too. It should be mentioned that the size of the grids in very fine simulation are decreased to half of the fine meshes.

Figure 26 shows comparison of the results of with different size of grids (in the experiment 1 for the first model). If the mesh sizes are smaller, the results are better and the errors in comparison to the experiment are decreased too.

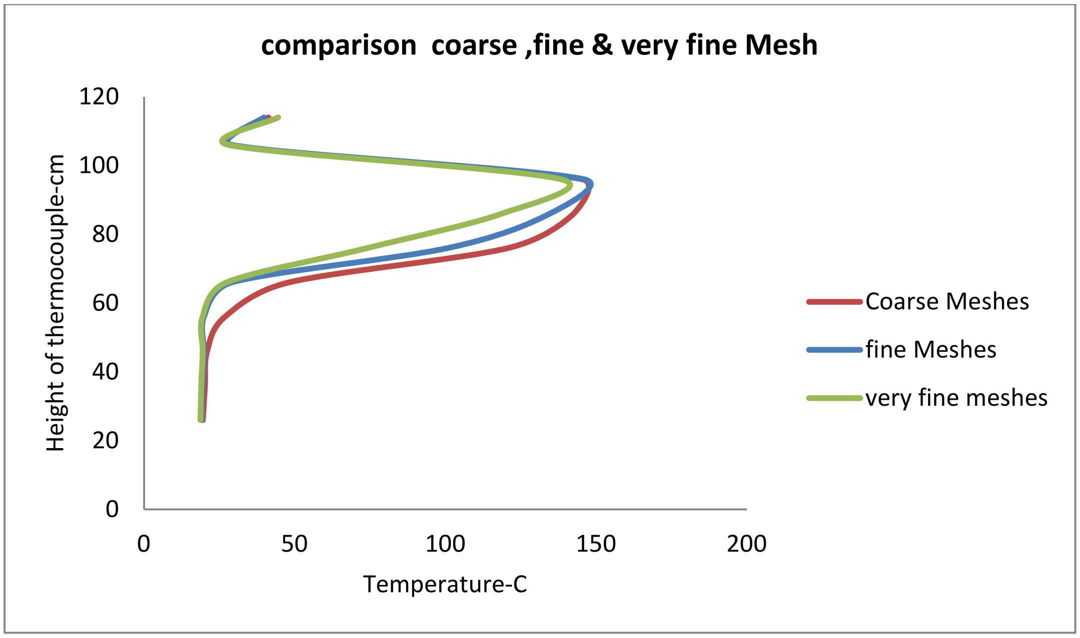

Figure 26–Comparison FDS different meshes in thermocouple middle of door

The hood and duct play an important role in the details of geometry but it is not clear how much effect they have on the results. In order to clarify the effect of the hood exhaust on the results, the exhaust of the hood (smoke exhaustion) was decreased almost 30% in the FDS modeling, then all of the models were simulated again.

Figures 27 and 28 present the comparison of the temperature of the thermocouple trees in the middle of the door and inside of the ½ scale ISO room in the experiment 1 and FDS with decreased exhaust of the hood.

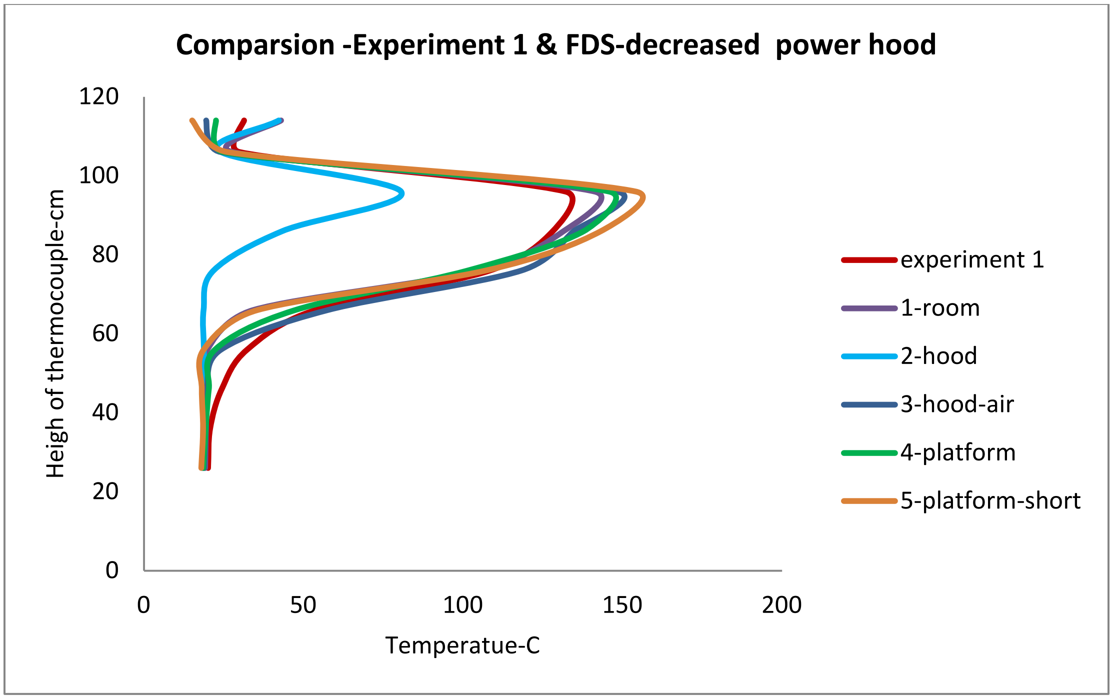

Figure 27-Comparison Temperature in thermocouple (middle) in EXP.1 &FDS (decreased exhaust of hood)

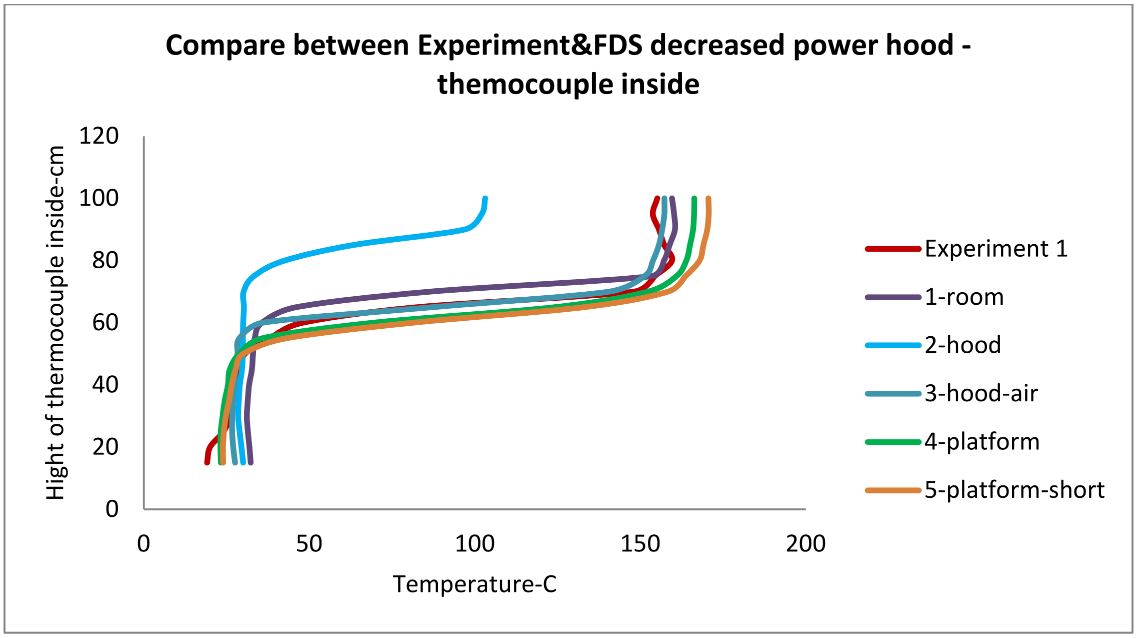

Figure 28–Comparison Temperature in thermocouple (inside) in EXP.1 & FDS (decreased exhaust of hood)

Generally, it can be seen from the figures 27 and 28, that the effect of decreased exhaust of the hood is not more than 5-8% in average error compare to simulation of experiment 1.

The similar results were found when comparing the experiment 2 with FDS models, the figures 29 and 30 express the temperature in the thermocouple trees in the middle of the door and inside the room for experiment 2.

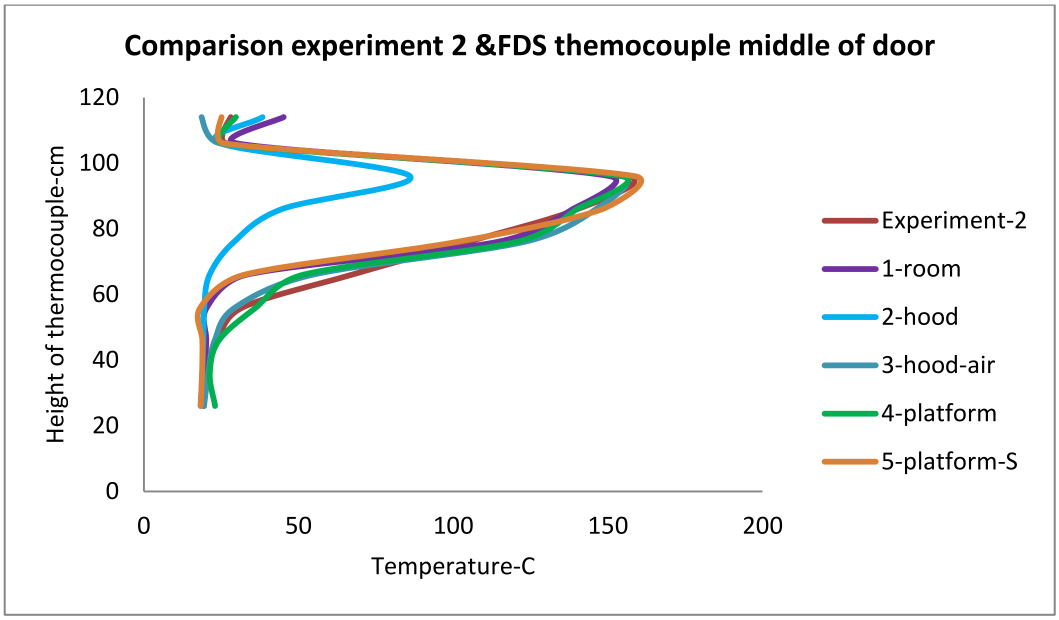

Figure 29–Comparison experiment 2 with FDS results in thermocouple middle of door

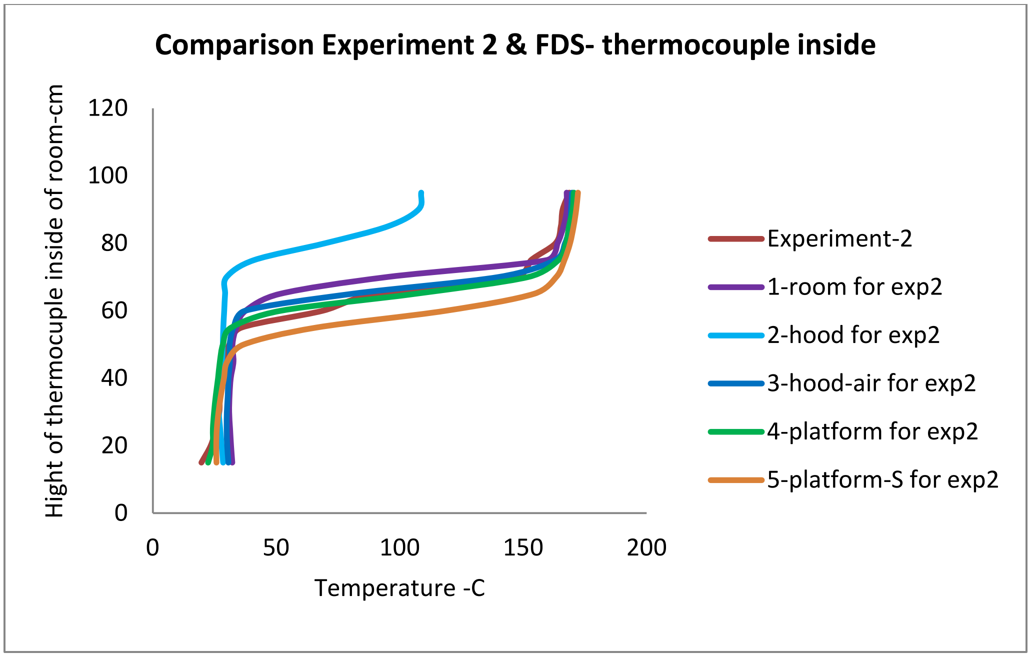

Figure 30–Comparison experiment 2 & FDS results in thermocouple inside of room

Flow velocities are also predicted by FDS. In figures 31, 32, and 33 the velocity at the exit from the door are shown. More discussion about the velocity can be found in the next chapter.

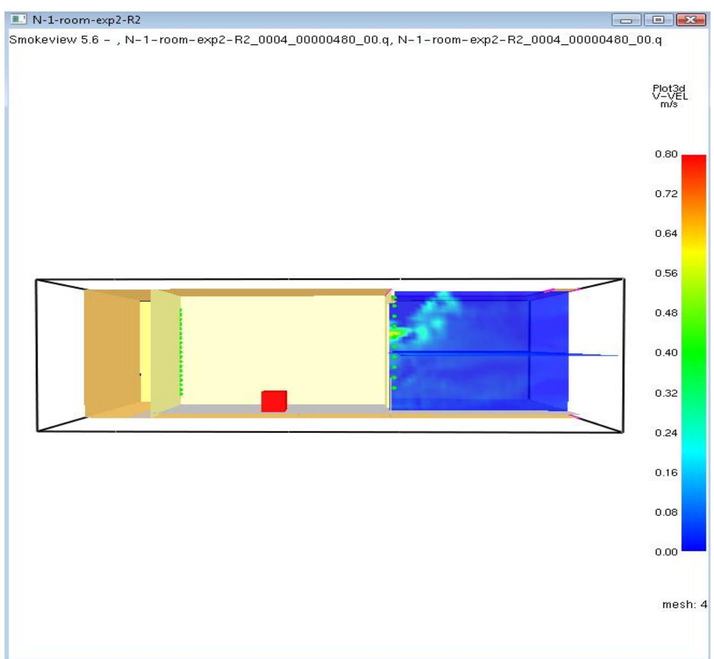

Figure 31-Velocity in first model (FDS simulation: experiment 1)

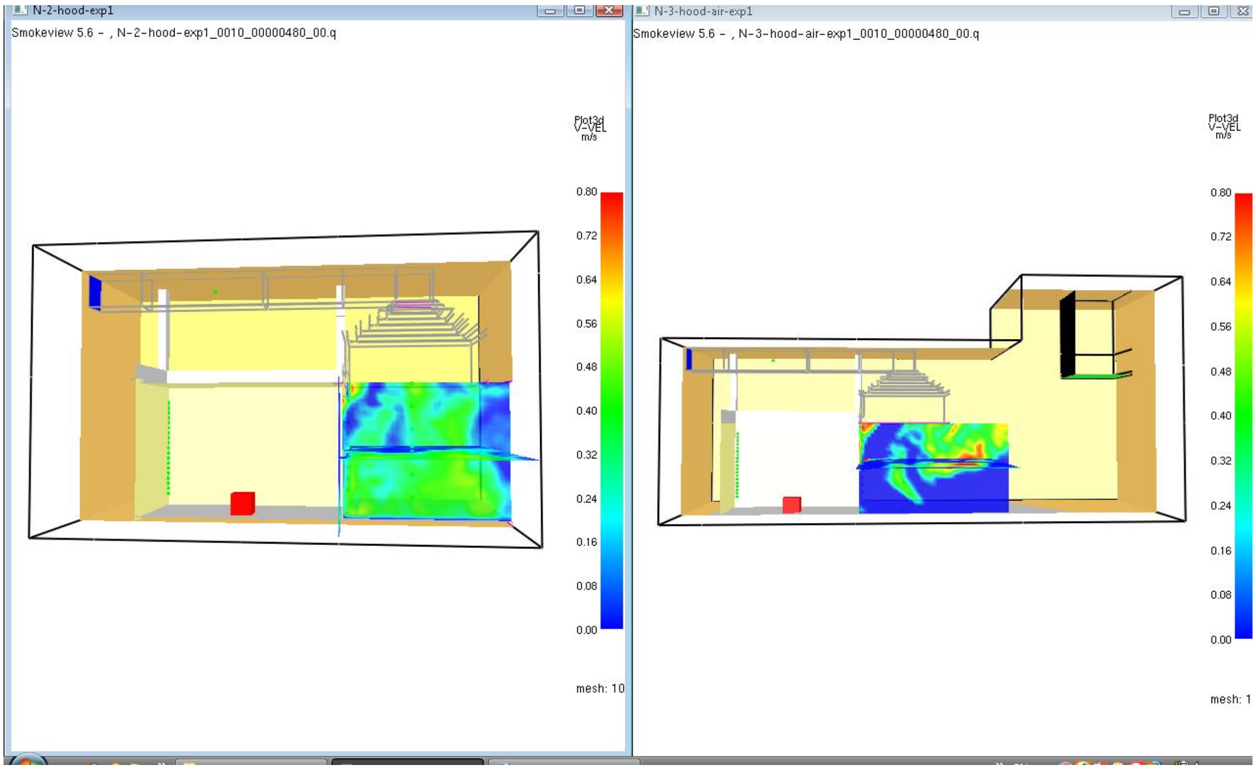

Figure 32-Velocity in second & third model (FDS simulation: experiment 1)

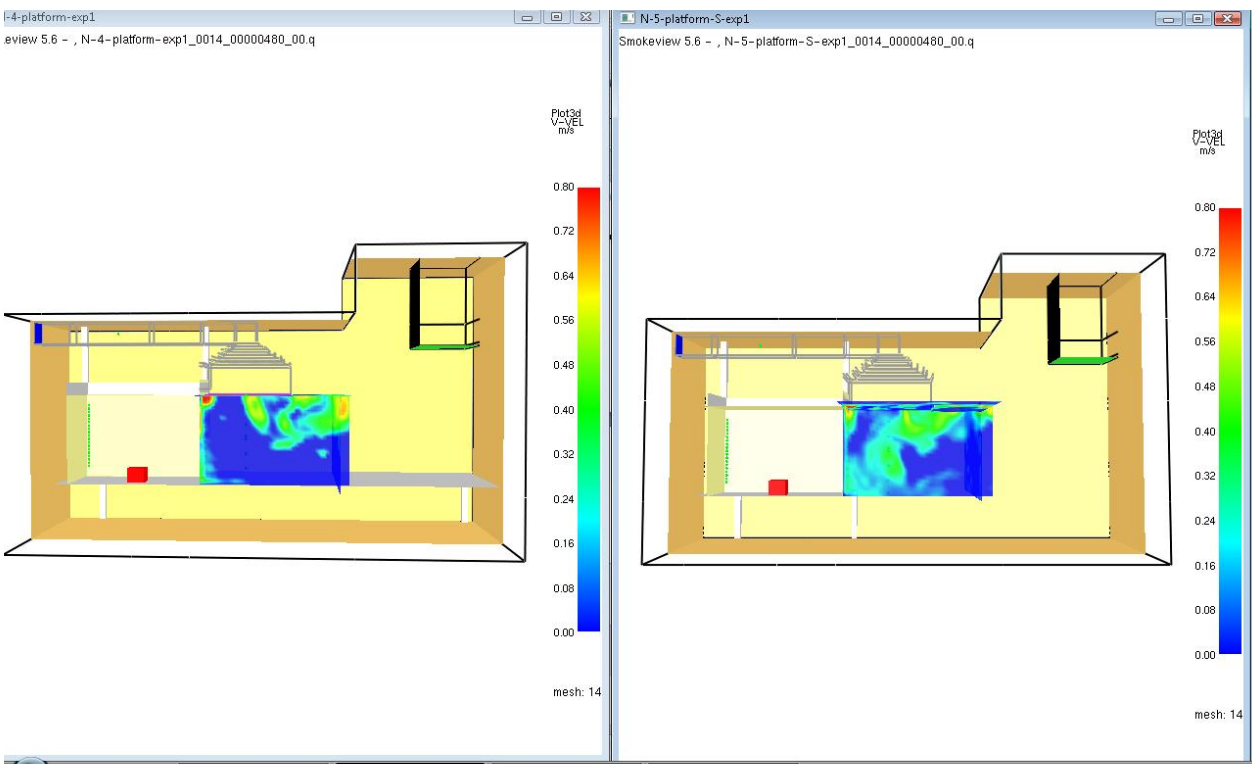

Figure 33-Velocity in fourth & fifth model (FDS simulation: experiment 1)

Detailed results of the velocity profiles for the other FDS simulations (experiment 2, experiment 1 with coarse meshes, and experiment 1 with decreased hood exhaust) can be found in the Appendix 9.1.

4 Discussion

The accuracy of the result in FDS is an important issue, and only the observation of results from graphs cannot provide a clear answer to the accuracy prediction, moreover; comparison between different simulations from graphs are difficult too. An 'Error function' is introduced as a suitable tool to show the accuracy of results from FDS simulations. The results from previous sections will be discussed in this chapter. The following section includes the error function and more investigations of the results.

4.1 Error

It is important to estimate the error in the different models of FDS simulations, in this part, an error function is used in order to predict the accuracy of FDS for simulations of the experiments. Generally, the prediction of error can be defined by the formula [25] below:

$$\text{Prediction of error} = \frac{\text{FDS result} - \text{Experimental result}}{\text{Experimental result}} \times 100\% \qquad \text{Equation 15}$$

Equation 15 is used for calculation of errors between experiment 1 and the FDS simulations. It should be mentioned that in the error calculation, a time averaged value for steady state (for the burning fuel during the period between 400 seconds and 600 seconds) is considered for both the experiments and FDS simulations.

In table 6 the percentage of the error from the different FDS models compared with the experiment 1 for the thermocouple tree in middle of door is shown.

Error FDS & Experiment 1 in thermocouple middle of door	Max-Error in experiment 1	Average –Error in experiment 1
Error 1-room& experiment 1	46.30	17.23
Error -2-hood& experiment 1	71.66	39.21
Error 3-hood-air& experiment 1	31.8	13.21
Error 4-platform& experiment 1	17.51	6.50
Error -5-platform-S& experiment 1	48.22	21.74

Table 6-Error calculated for experiment 1 and FDS in thermocouple middle of door

Similarly, table 7 shows the error of FDS simulation of experiment 1 for the thermocouples inside the room.

Error FDS & Experiment 1in thermocouple inside room	Max-Error in experiment 1	Average –Error in experiment 1
Error 1-room& experiment 1	56.57	17.79
Error -2-hood& experiment 1	79.37	37.33
Error 3-hood-air& experiment 1	52.49	14.90
Error 4-platform& experiment 1	23.92	7.30
Error -5-platform-S& experiment 1	77.10	20.02

Table 7-Error calculated for experiment 1 and FDS simulation in thermocouple inside of room

It can be seen from table 6 and 7 that the average error for the second model ‘‘2 –hood’’ is the biggest and the error for the fourth model is the smallest.

The accuracy of FDS in the second model has the lowest accuracy of all the models. It seems logical because in the second model ''2-hood'' the boundary is very close to the hood system and the air supplier is ignored in the simulation. According to Bernoulli's equation, there is less loss in this model (compared to the third, fourth and fifth models) thus it predicts more turbulent flow, higher velocity and lower temperature profile (below the hood) in this model. Therefore, the largest deviation between numerical results and the experiment was found in this model and should be considered not a perfect choice.

When looking at the results from the third model ''3-hood-air'' in the FDS simulation where air supply (from outside) is considered too, the error is decreased where compared to the first and second models because this model almost look like the real situation and simulated both the hood, duct and air supplier together. The comparisons between simulations and experiments show that the fourth model ''4-platform'' provides the most accurate results. The results of the fifth model ''5-platform-S'' that was considering a short platform shows more air comes into the ½ scale room so it is expected that there is a higher temperature and velocity in this model.

Significantly, one should note that the experiment values are used as the source of base in order to estimate error in the FDS simulations, but it is necessary to consider that the experimental data have not always 100% accuracy either. It should be marked that there were some errors also in the experiments, which are illustrated more in the Error part.

The figures 34 -37 show the details of error at each level of the thermocouple tree in the middle of the door and inside the ½ scale ISO room.

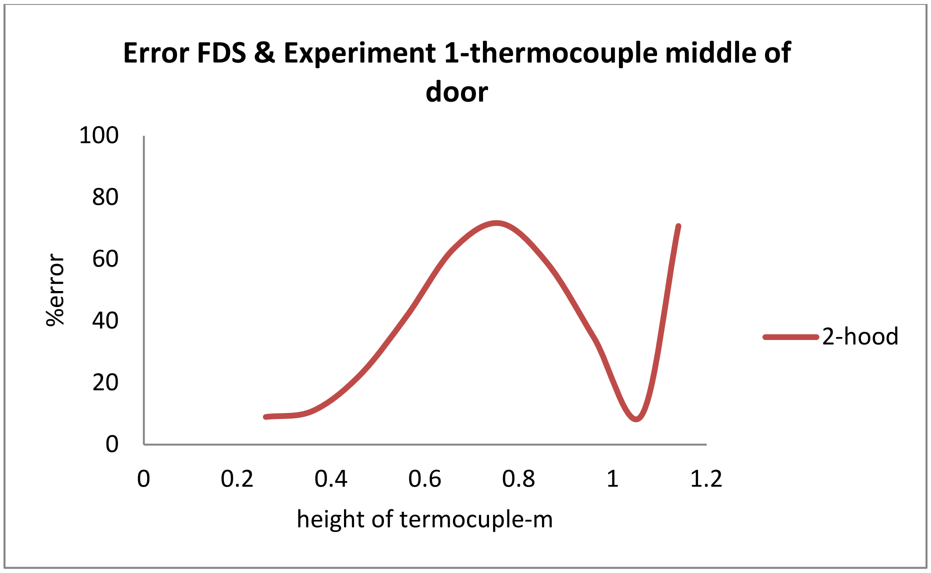

Figure 34-Detail of errors in level of thermocouple tree between "2-hood" and Exp. 1

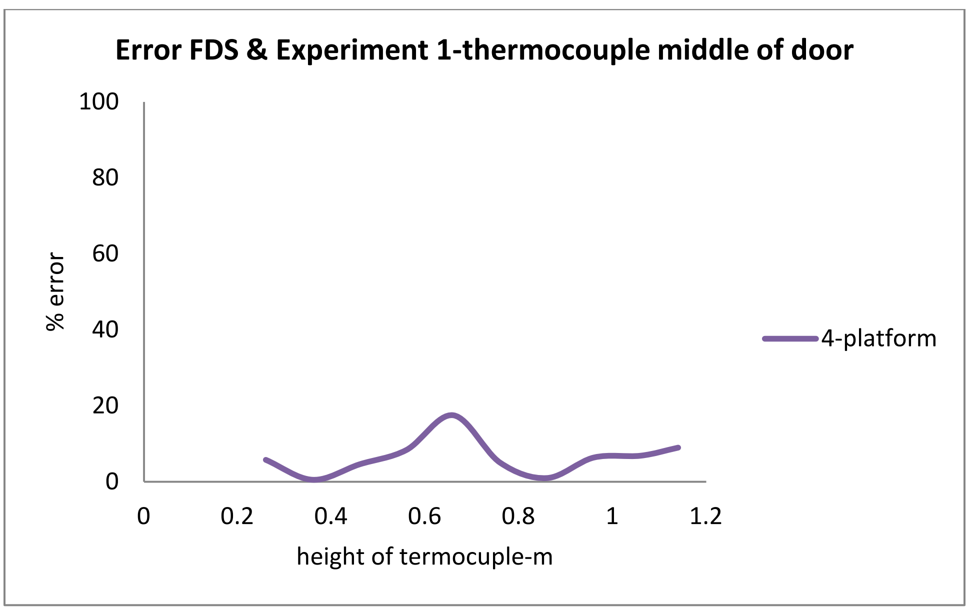

Figure 35-Detail of errors in level of thermocouple tree between "4-platform" and Exp. 1

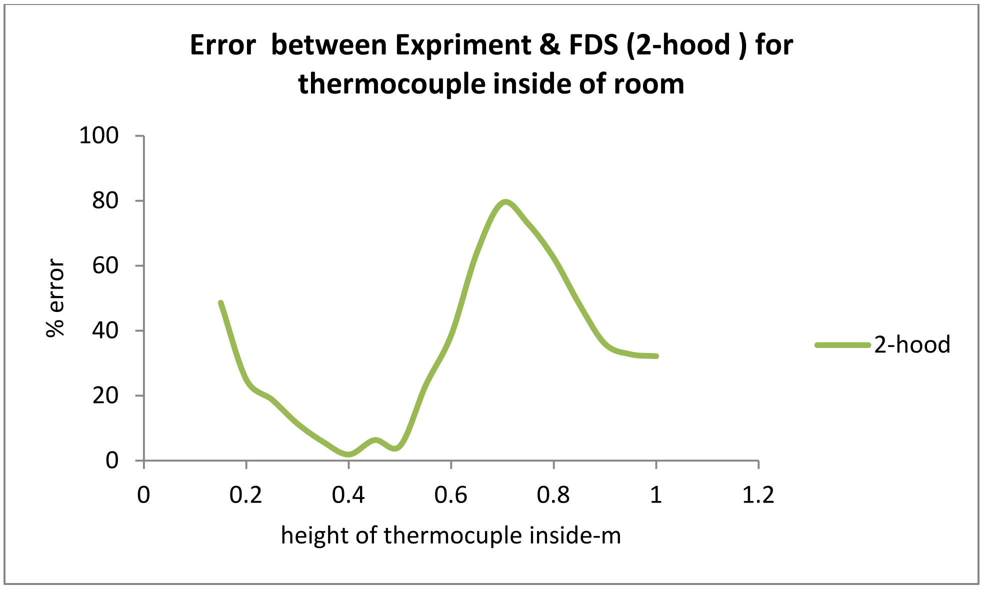

Figure 36-Detail of errors in level of thermocouple tree (inside) between "2-hood" and Exp.1

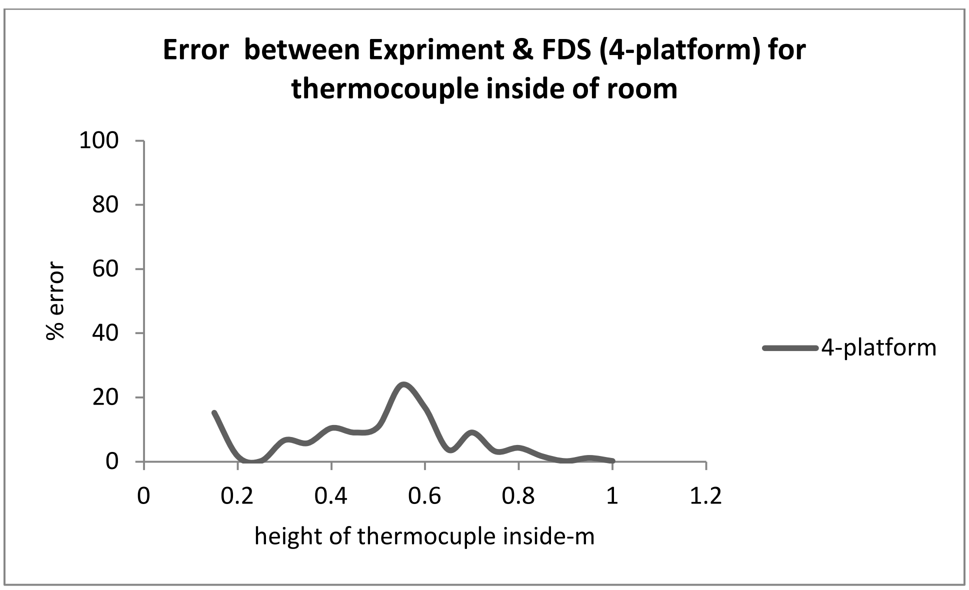

Figure 37-Detail of errors in height of thermocouple (inside) between "4-platform" and experiment 1

It can be seen by looking at the graph 34 and 36 compared to the graph 35 and 37 that the maximum error is approximately between 0.55-0.75 m from the floor of the ½ scale ISO room, which is the same height as the neutral plane. According to the definition of the neutral plane, it is as a reference height where the pressure difference will be zero [26], and cold gas (air) will come into the ½ scale ISO room at the bottom and hot gas (smoke) will exit above this height. Nevertheless, in the real experiment, the neutral plane was not an exact height, it was rather a range of heights where some turbulent flow was observed. Therefore, it seems correct to have the biggest error in this zone.

Figure 38 illustrates the position of the height of the neutral plane in the experiment; the turbulent flow at the neutral height area is seen easily in figure 38. It should be mentioned that the neutral height was between 58-68cm in the first experiment.

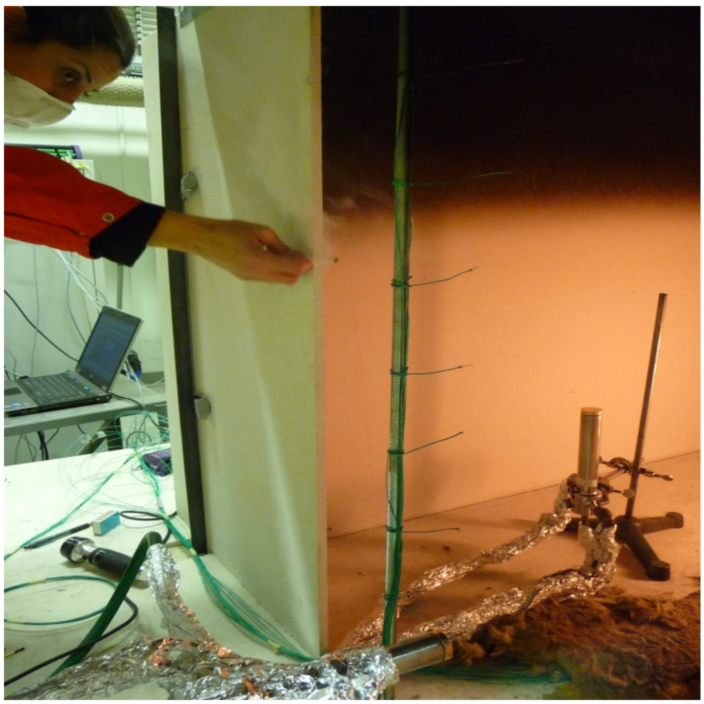

Figure 38-Turbulence flow in neutral height

In order to validate and verify, all of the five models that were simulated results from experiment 2, where also investigated here. Similar results are found when comparing the data from the experiment 2 with the FDS results.

Tables 8 and 9 show maximum and averaged errors from the different FDS models compared with the experiment 2 for the thermocouple trees in middle of door and inside of the room.

Error FDS & Experiment 2 in thermocouple middle of door	Max-Error in experiment 2	Average –Error in experiment 2
Error 1-room&experiment 2	60.78	20.64
Error -2-hood& experiment 2	72.18	36.27
Error 3-hood-air& experiment 2	33.67	10.68
Error 4-platform& experiment 2	23.35	7.82
Error -5-platform-S& experiment 2	51.67	16.68

Table 8- Error calculated for the experiment 2 and FDS simulation in thermocouple tree middle of door

Error FDS & Experiment 2 in thermocouple inside room	Max-Error in experiment 2	Average –Error in experiment 2
Error 1-room& experiment 2	63.70	18.63
Error -2-hood& experiment 2	79.70	32.72
Error 3-hood-air& experiment 2	55.65	13.26
Error 4-platform& experiment 2	24.63	7.58
Error -5-platform-S& experiment 2	84.32	19.47

Table 9-Error calculated for the experiment 2 and FDS simulation in thermocouple tree inside of room

Similarly, the lowest error is related to the fourth model ''4-platform'' where everything is simulated and the second model ''2- hood'' has the biggest error due to the reasons that were discussed for experiment 1.

Figures 39-42 presents details of the errors that occurred at the thermocouple height. When looking at the results, the maximum error is in the neutral plane zone (same as for experiment 1).

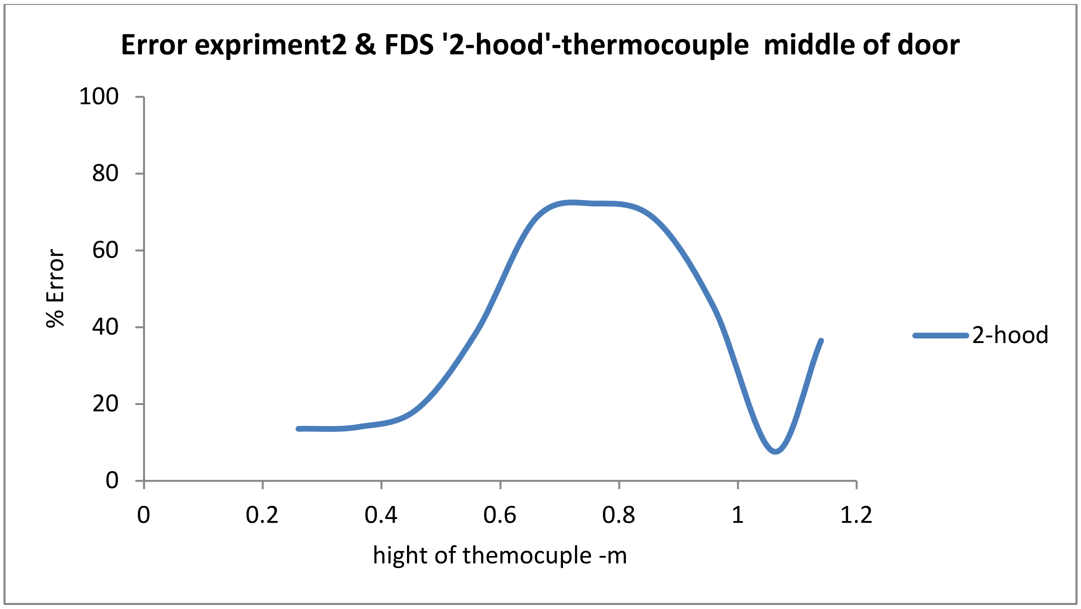

Figure 39-Detail of errors in height of thermocouple between '2-hood' model and experiment 2

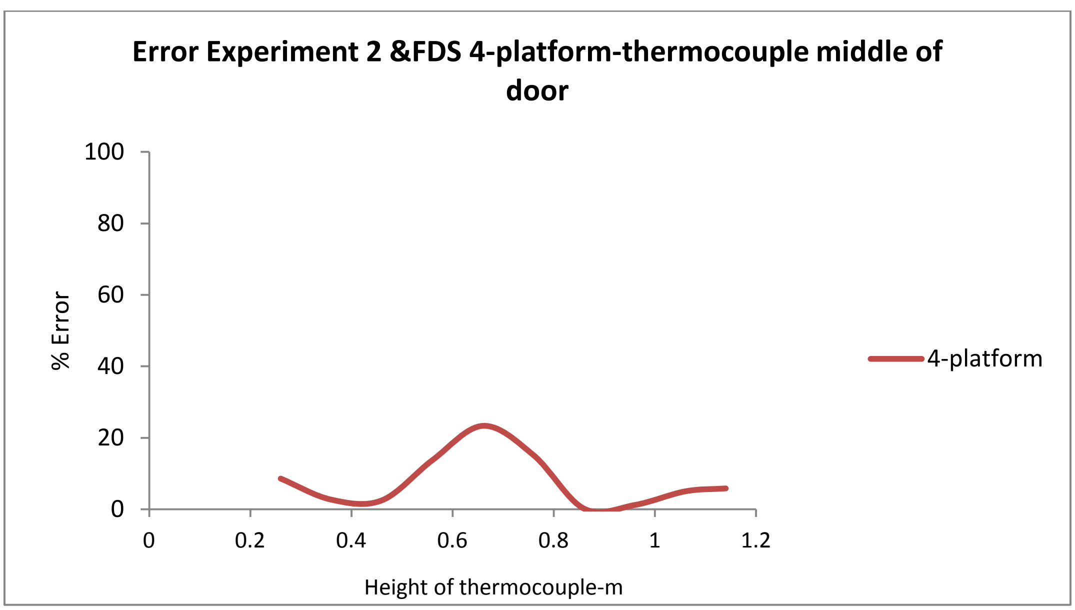

Figure 40-Detail of errors in height of thermocouple between '4-platform' & experiment 2

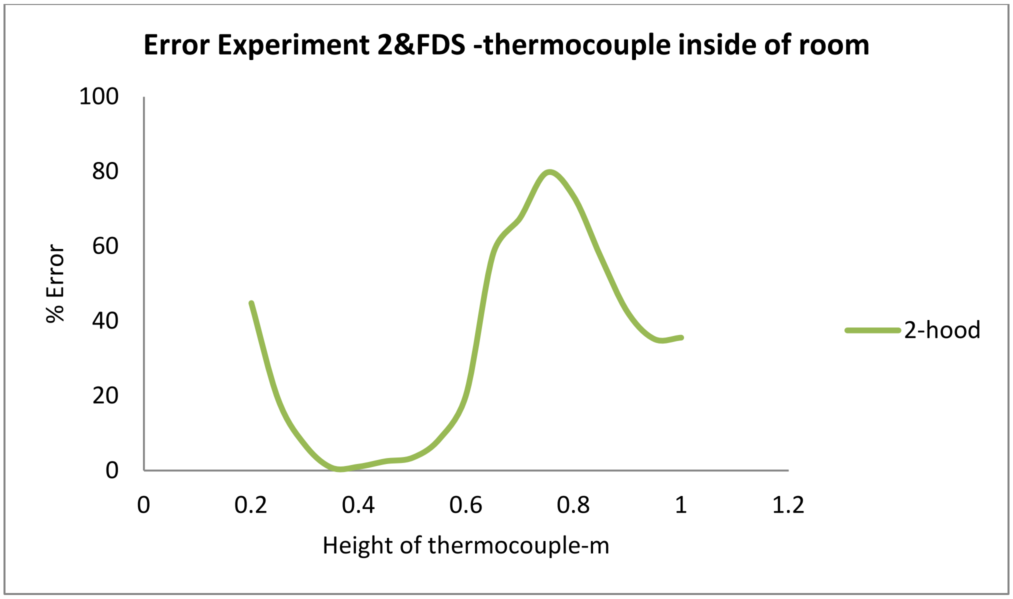

Figure 41-Detail of errors in height of thermocouple (inside) between '2-hood' &experiment 2

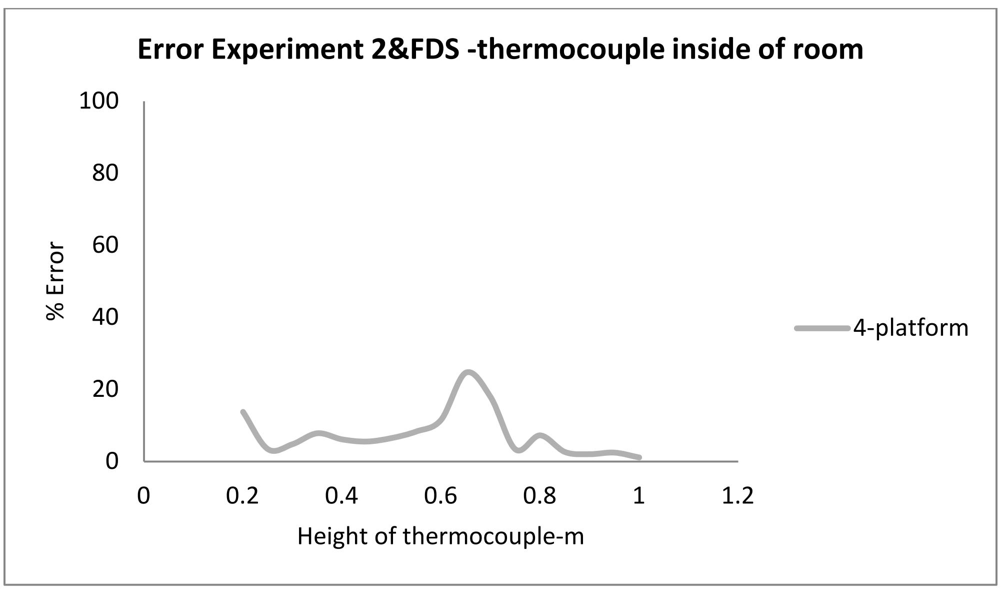

Figure 42-Detail of errors in height of thermocouple (inside) between '4-platform' & experiment 2

In general (by looking at results from tables 6,7,8 and 9), 17-21% errors are predicted in the first model ''1-room'' because the complex geometry, hood, duct, air supplier from out of the laboratory, platform and other factors such as boundary are ignored and they have effects on the results. On the other hand, it can be seen from the tables 6, 7, 8 and 9 that the error resulting from the fourth model ''4-platform'' compared with the third model '3-hood-air' were decreased, moreover, the accuracy of FDS is the highest and best in the fourth model when the platform was added in the simulation . When looking at the results presented in the tables, the average of the error in the fourth model is less than 7.5%, which is ''excellent'' according to previous studies [25].

Percentage of errors is presented in table 10 for the thermocouples in the middle of the door in experiment 1, simulation with coarse meshes. These results from tables 6 and 10 show that FDS prediction were found to give more than 20% error where a coarse mesh was used.

Error experiment 1 with FDS –thermocouple in the middle of door	Max Error coarse in experiment 1	Average Error coarse in experiment 1
Error experiment 1 &FDS '4-platform' from-Coarse mesh	69.76	29.89

Table 10- Error calculated for experiment 1 and FDS (Coarse) for the fourth model

Table 11 shows maximum and average errors between experiment1 and the FDS simulations for very fine and coarse grids.

Error experiment 1 with FDS –thermocouple in the middle of door	Max Error coarse in experiment 1	Average Error coarse in experiment 1
Error experiment 1 &FDS '1-room' from-Coarse mesh	59.73	32.65
Error experiment 1 &FDS '1-room' from-Very fine mesh	40.10	14.95

Table 11- Error calculated for experiment 1 and FDS (Coarse & very fine) for the first model

It should be mentioned that the error would be decreased to around 3-6% when very fine meshes are used in simulations instead of fine (by looking at results from table11 and table 6). This results show that by increasing the grid resolution the results improved.

Figure 31 (velocity profile) shows that for the first simple model ''1-room'' (without considering hood, duct, air supplier and platform), the velocity of air coming into ½ scale ISO room is less than for the other models. Furthermore, velocity of air coming into the room in the second model ''2-hood'' is higher than for the others.

Figure 43 shows a comparison between the velocities in the fourth and fifth models. It should be mentioned that the location of the device, which is defined (in the FDS simulation) is below the hood and 60cm distance from the door of the ½ scale room. In figure 43 showing the velocity, the positive values indicate air coming into the room and negative values shows air/smoke coming out of the room.

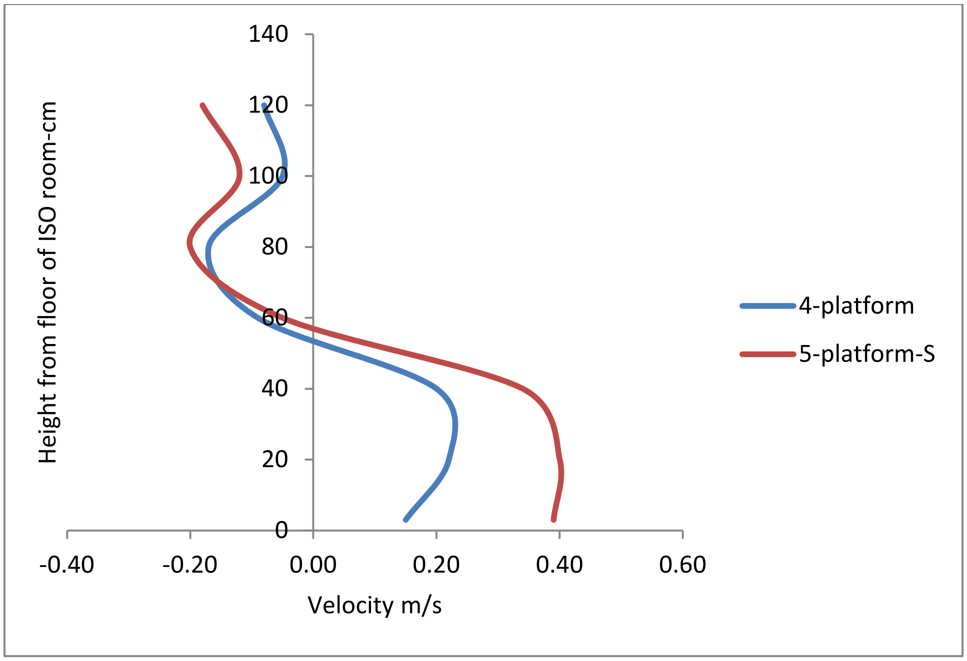

Figure 43-Comparison velocity between the fourth and fifth models

If the results for ''4-platform'' is compared with the fifth model ''5-platform-S'', velocity of air coming into the ½ scale ISO room is increased in the model ''5-platform-S'', this is shown in figure 43. This can be explained by the fact that there is a short platform and more air can come in from the air source and boundary, but in the fourth model due to a long platform, which is the same as an obstacle for air, it is expected that velocity in this model is less than for the fifth model. It shows that the fifth model has a suitable design if a new experimental set up will be built in the future.

4.2 Source of errors:

Although, the experiments are used as base for comparison with the FDS simulations errors in the experiments are unavoidable. In this part, some sources of error in the FDS and experiments are introduced in separate parts.

4.2.1 Sources of errors in experiment

There are several sources of errors in the experiments that may have some effect on the results, one is that just the period of steady state is used. Although, the data measurements from the experiments were made during nominally steady state conditions, fluctuations in different measurements (for example temperature, mass, flow rate, velocity) happened during the sampling period. These effects the results of the experiment, therefore, the experimental data were determined in terms of a time averaged mean value with an associated standard error [27].

Another error can be connected to the initial conditions (e.g. initial temperature) in the experiments, because in the second experiment more time was needed (e.g. time to cool down the enclosure) to reach initial conditions. Sometimes, this time is less (especially when experiments were done consecutively) sometimes, it takes longer to start the experiment. This can affect the results (particularly, the temperature measured with thermocouple).

As was expressed before (the part with results from the experiment), the accuracy of the temperature that was recorded in the thermocouple tree (especially inside of the ½ scale ISO room) is difficult to assess. Due to the fact that there were soot in the room and it had effect on the sensitivity of the temperature measurements, it seems that this is one source of error in the experiments.

Even very small changes in location of a device such as thermocouples could give a significant effect on the results from experiments, error caused by this should be considered. For example, this can be very sensitive for the thermocouple (middle of door) of neutral plane position, a small change can mean that they change position from hot layer to cold layer. It was not avoidable that there was uncertainty in the exact position of the device and there was almost an approximate error of 20 mm in the experiments. It is not possible completely to avoid errors in the experiment work.

4.2.2 Error sources in FDS simulation:

The predictions of quantities in the FDS strongly depend on several factors such as correct simulations of geometry, boundary, and size of meshes, etc.

According to FDS approximates the governing equation is based on rectilinear grid [28]. Another error is that FDS is unable to model circular geometries. As is explained before (in the simulation section), the fuel pan was circular and the duct had circular section in the experiments. However, in FDS, it was considered to have a rectangular section. Therefore, there is a discrepancy when the experiment is simulated with FDS, which can have an effect on the results.

It should be noted that existing computers cannot solve DNS (Direct Numerical Simulation) for the case of this study, so there is the error due to the use of LES (Large Eddy Simulation) instead. It should be considered that the accuracy of HRR increases when CO2, CO, etc are included [12]. Moreover; initial temperature corresponds to the experiments.

5 Conclusions

This study aimed at assessing how the geometry and boundary conditions e.g. hood, duct, ventilation (air source), and constructions outside the enclosure effects the results of FDS simulations of a ½ scale ISO room.

We evaluate the errors in these simulations by comparison of the calculated temperature at the middle of the door and inside of the room to the corresponding temperature data measured by thermocouple trees in the experiments.

Results show that the fourth model ‘‘4-platform’’ provides the most accurate results. In this model, the hood, duct, ventilation system (air source), and platform are included in the simulations. The time-averaged errors between the results from this model and the experiments were less than 7.5% during the period between 400 seconds and 600 seconds. This is a very promising result compared to the existing literature [24].

The averaged error was found to be about 17-21 % in the first model, which is the most simplified model in terms of details of the geometry and boundary condition. The second model led to the poorest results. Although, this model included more details than the first model, the open-boundary was located at a position too close to the hood and it should be considered as an example of a not perfect choice.

In the third model, the air supplier was considered while the platform was not included. The results of this model were an improvement on both the first and second model.

The fifth model had the highest temperature. This is attributed to the use of a shorter platform and a larger air flow entrainment. The results of this case show that the performance of ventilation and air entrainment in this case are optimized. It is therefore suggested that this design be used in future construction/modification of the ISO room. In all models, the biggest errors were near the neutral plane, where the flow has the maximum turbulence intensity.

The effect of grid resolution was also examined. Three grid resolutions for the first model and two grid resolutions for the other models were examined. By increasing the grid resolution, the results improved. For example in the first model, increasing the grid resolution from coarse grid to fine grid decreased the error from 32.7 % to 17.2%. However, further increasing the grid resolution from fine to the finest grid in this case only gave a decrease in error from 17.2% to 14.95%. This implies that the results are still grid dependent. Even finer grids maybe required to obtain grids independent results.

6 Further work

According to the fact that there are many subjects to be studied in this research field, some of them that can be interesting to study in future are expressed briefly in this section.

Due to the results obtained in this thesis, one important area for further research can be the investigation of the effect of ventilation systems and complex geometry in a full scale ISO room by using simulation in FDS and real experiment.

Moreover, it is suggested to include simulation of the parts of the ventilation system above the door and the three small ventilators in the corner of the laboratory that were excluded in this study, in order to study how much the results change if all the details in the laboratory are considered to the simulations. Further, studies can be done for the items below:

- Different fuel (such as Methanol ,Methane, Propane)
- Different position of tray with fuel(for example in the corner)
- Different scale of the room test
- Simulation of layout such as ventilation ,excluding the room
- Investigate other parameters (burning rate, smoke flow patterns)in the FDS simulations

In addition, another interesting subject is to investigate the effect of air and ventilation in the laboratory environment on the shape of flame and to estimate the error in the simulations when the ventilation is working.

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In particular, I would like to thank the following people:

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9 Appendices

9.1 Results in FDS

9.1.1 Result of FDS for experiment 2:

9.1.1.1 Temperature

Figures 43-45 present temperature profiles for experiment 2.

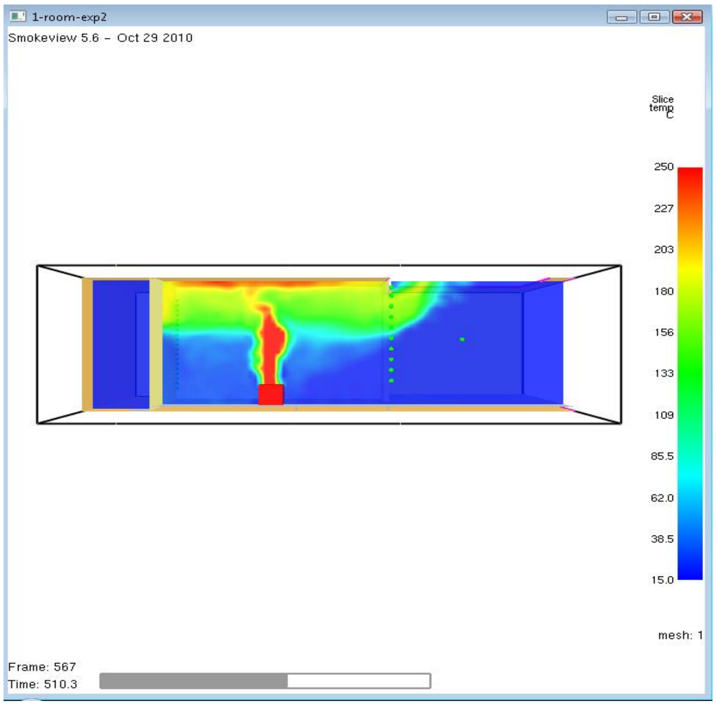

Figure 44- Temperature profiles in first model (FDS simulation: experiment 2)

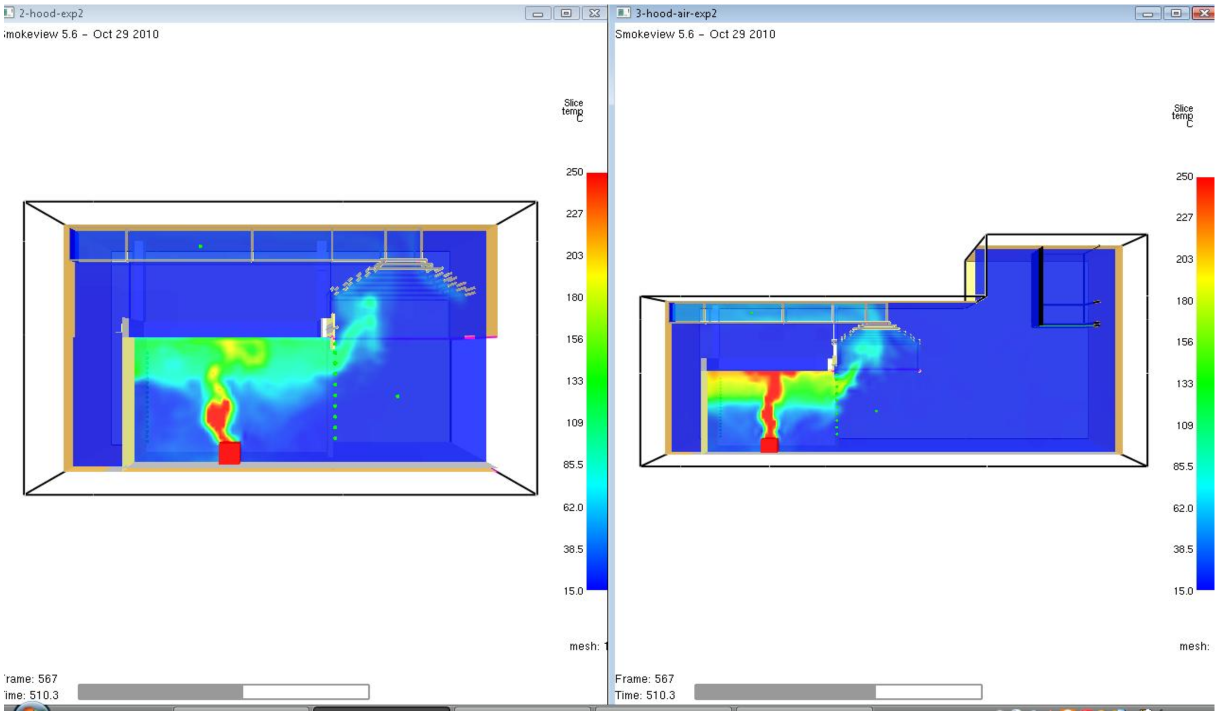

Figure 45-Temperature profiles in second &third model (FDS simulation: experiment 2)

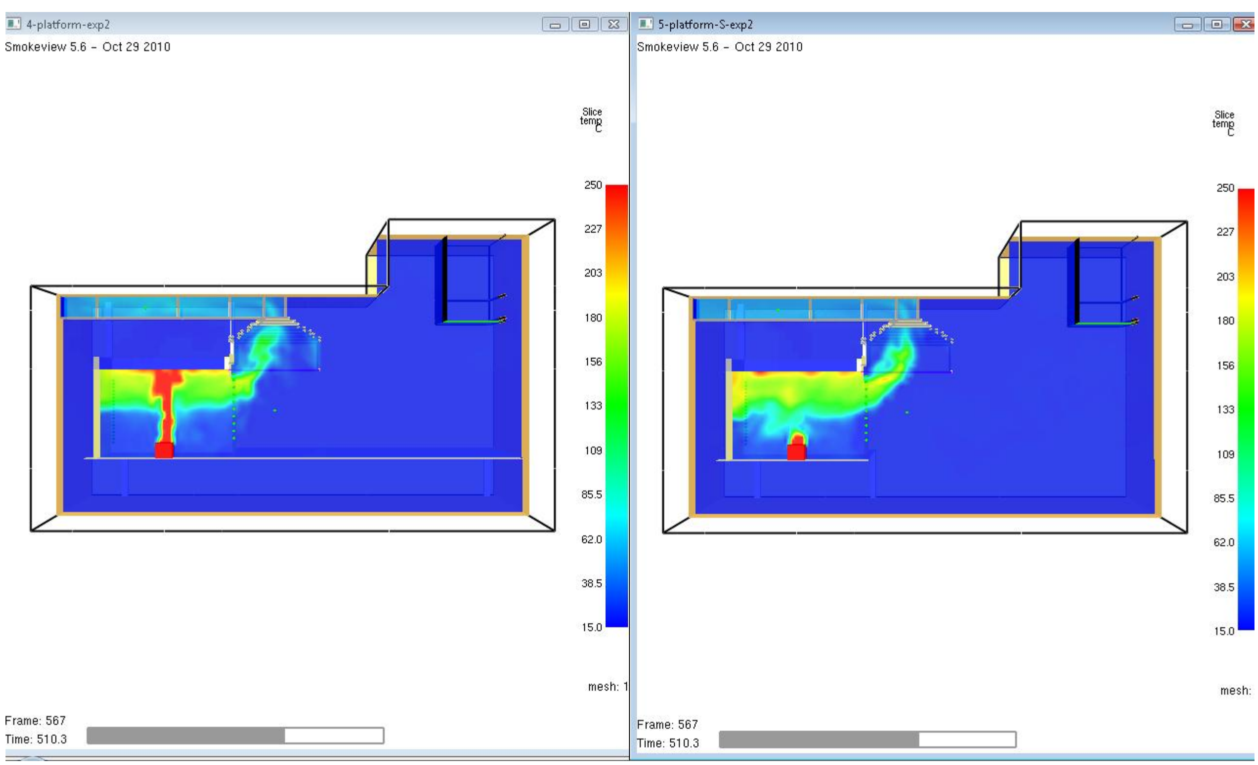

Figure 46- Temperature profiles in fourth & fifth model (FDS simulation: experiment 2)

9.1.1.2 Velocity

The velocities from simulation in FDS for experiment 2 are presented in the figures below.

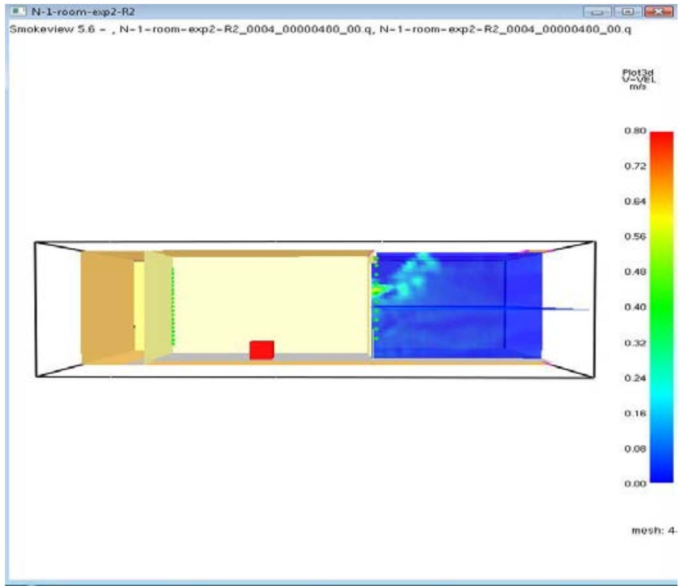

Figure 47- Velocity in first model (FDS simulation: experiment 2)

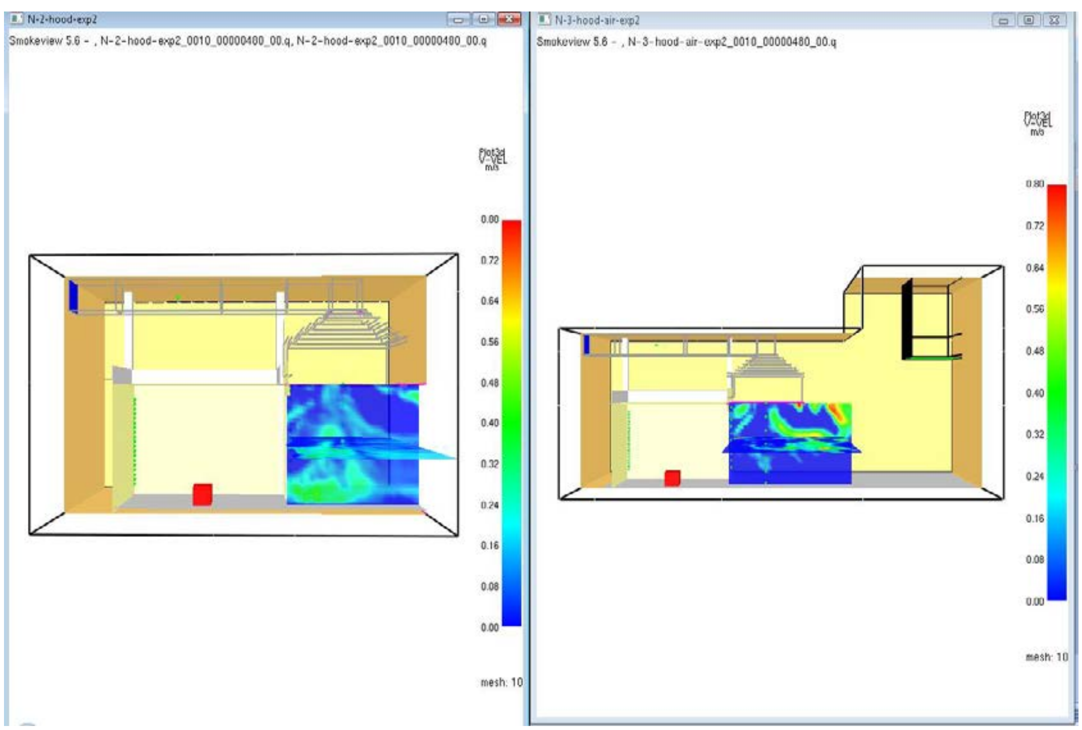

Figure 48- Velocity in second & third model (FDS simulation: experiment 2)

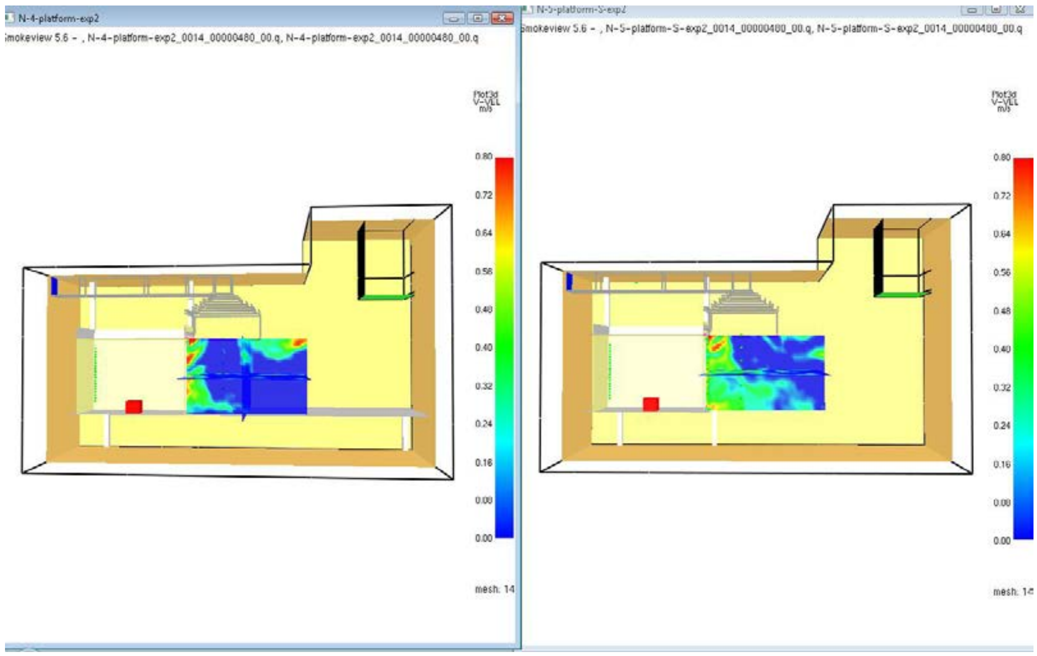

Figure 49- Velocity in fourth & fifth model (FDS simulation: experiment 2)

9.1.2 Result of FDS for experiment 1 coarse meshes

9.1.2.1 Temperature

The temperature results from the FDS are shown in figures below for coarse grids in all of the simulations.

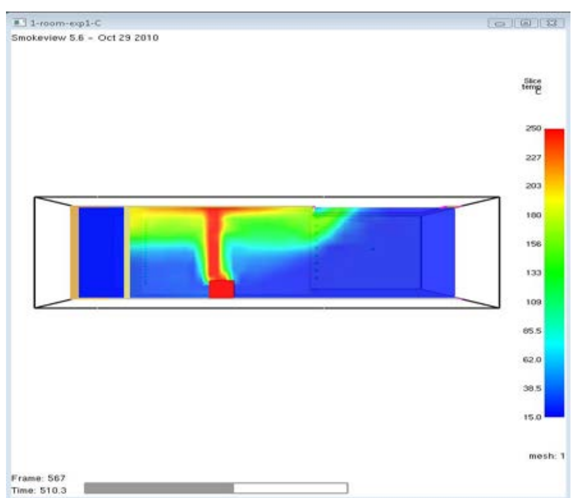

Figure 50- Temperature profiles in first model (FDS coarse meshes: Exp. 1)

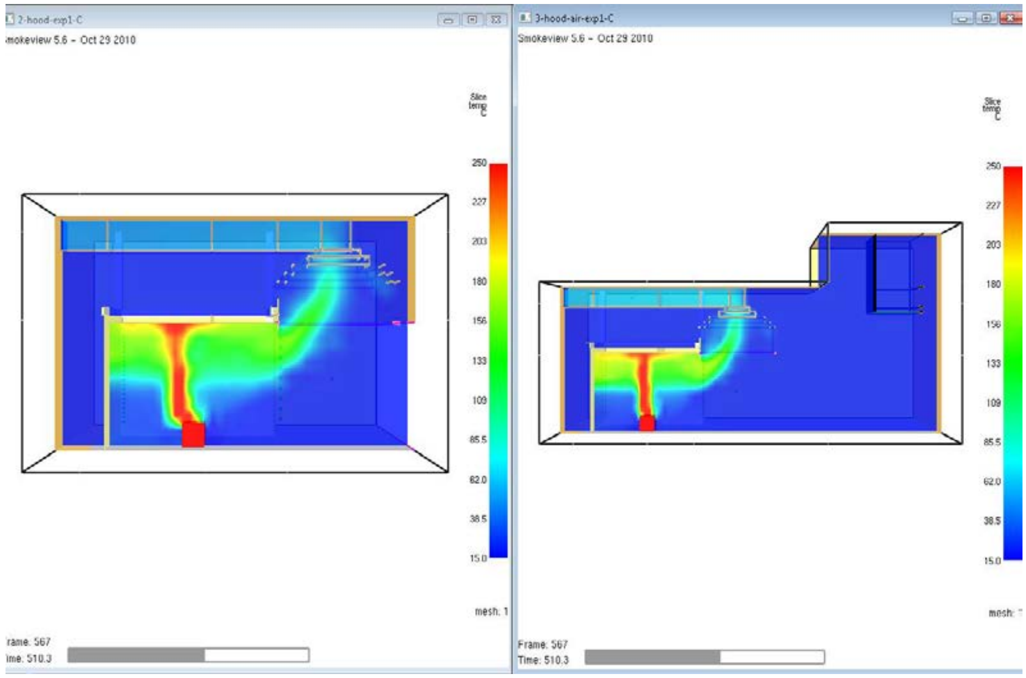

Figure 51 -Temperature profiles in second &third model (FDS coarse meshes: Exp. 1)

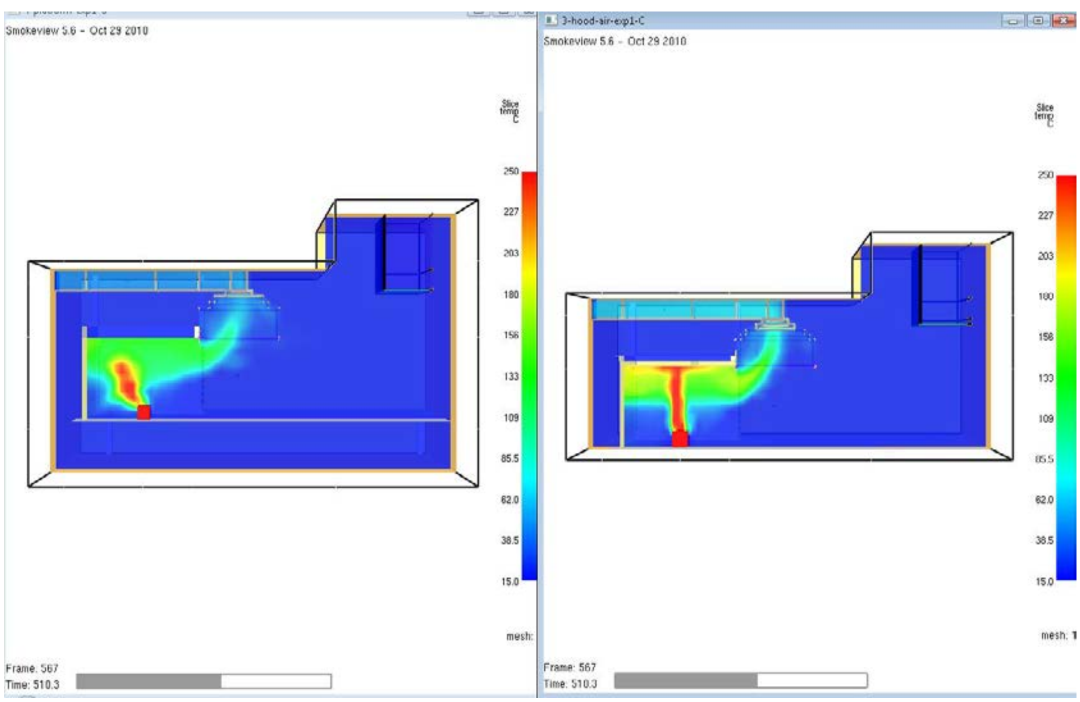

Figure 52- Temperature profiles in fourth & fifth model (FDS coarse meshes: Exp. 1)

9.1.2.2 Velocity

Velocity profiles are presented for coarse meshes in the figures below.

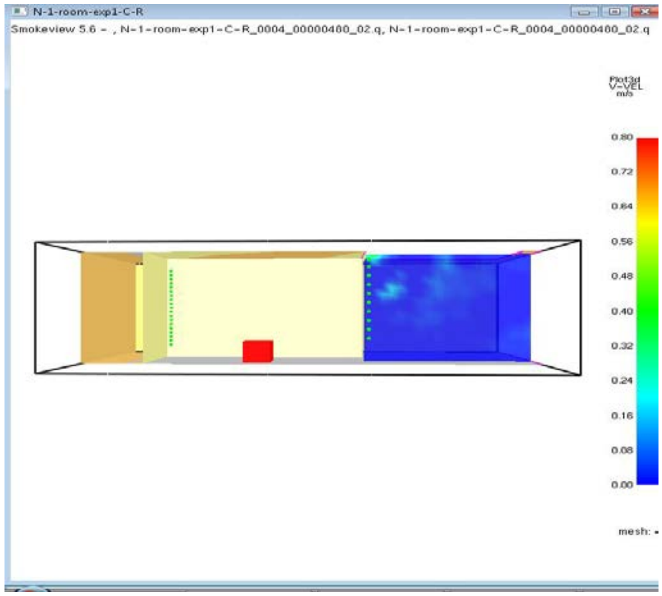

Figure 53- Velocity in first model (FDS coarse meshes: Exp. 1)

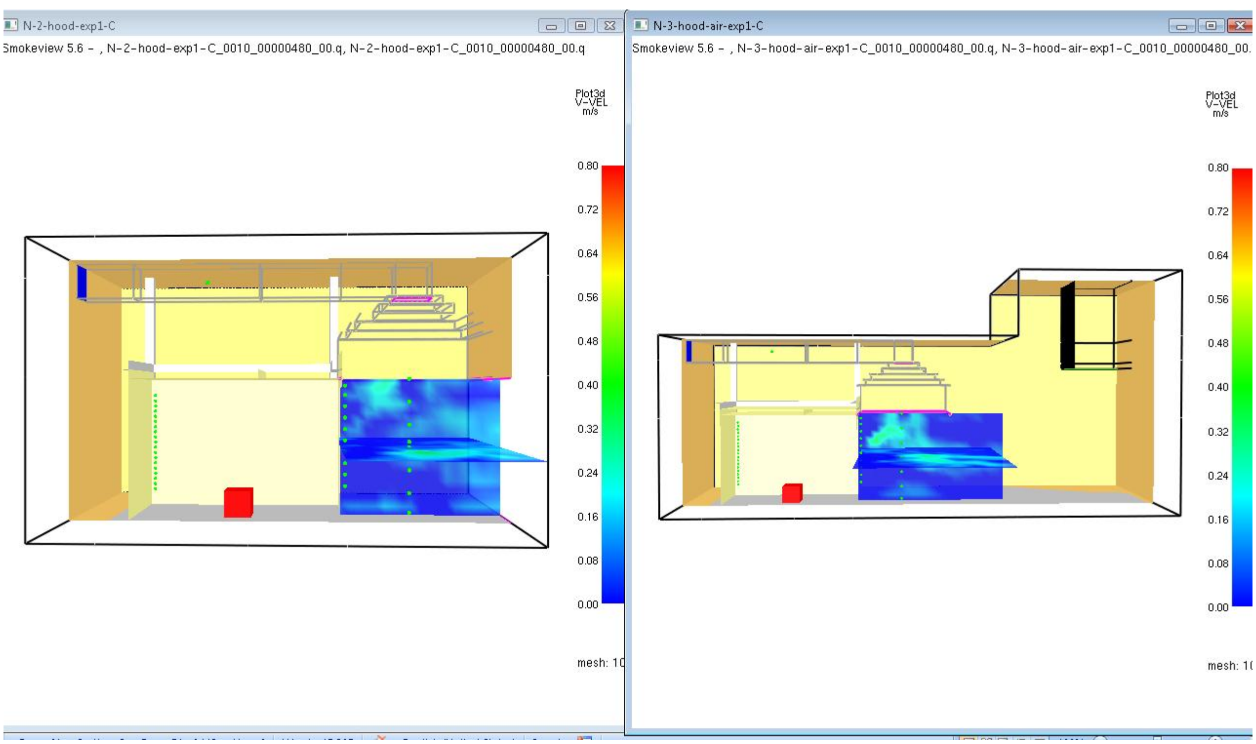

Figure 54- Velocity in second & third model (FDS coarse meshes: Exp. 1)

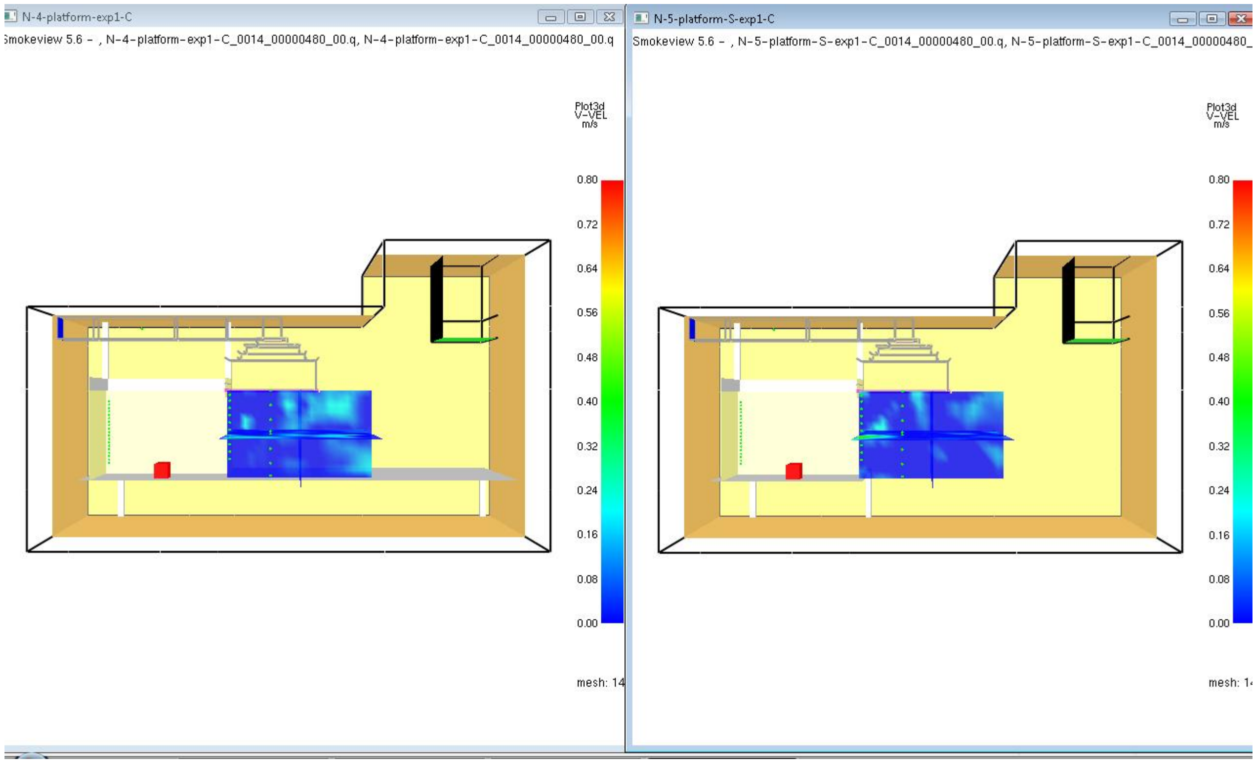

Figure 55- Velocity in fourth & fifth model (FDS coarse meshes: Exp. 1)

9.1.3 Result of FDS (decreasing the hood exhaust) for experiment 1

9.1.3.1 Temperature

Temperature profiles are presented for decreasing the hood exhaust in the figures below.

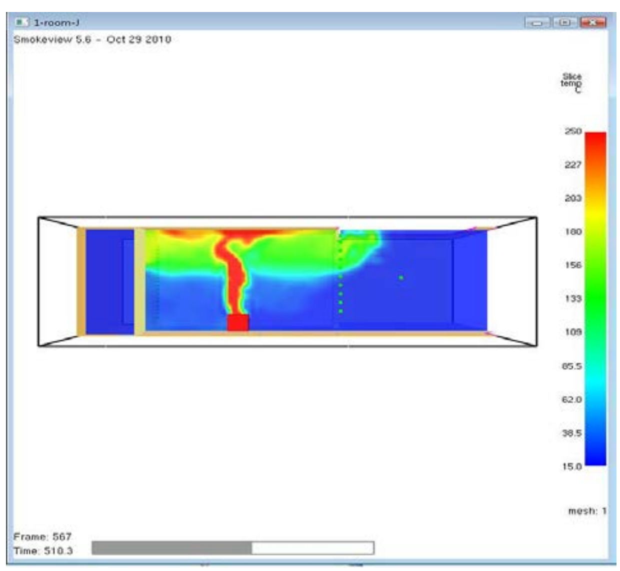

Figure 56- Temperature profile in first model (FDS decreased the hood exhaust: Exp. 1)

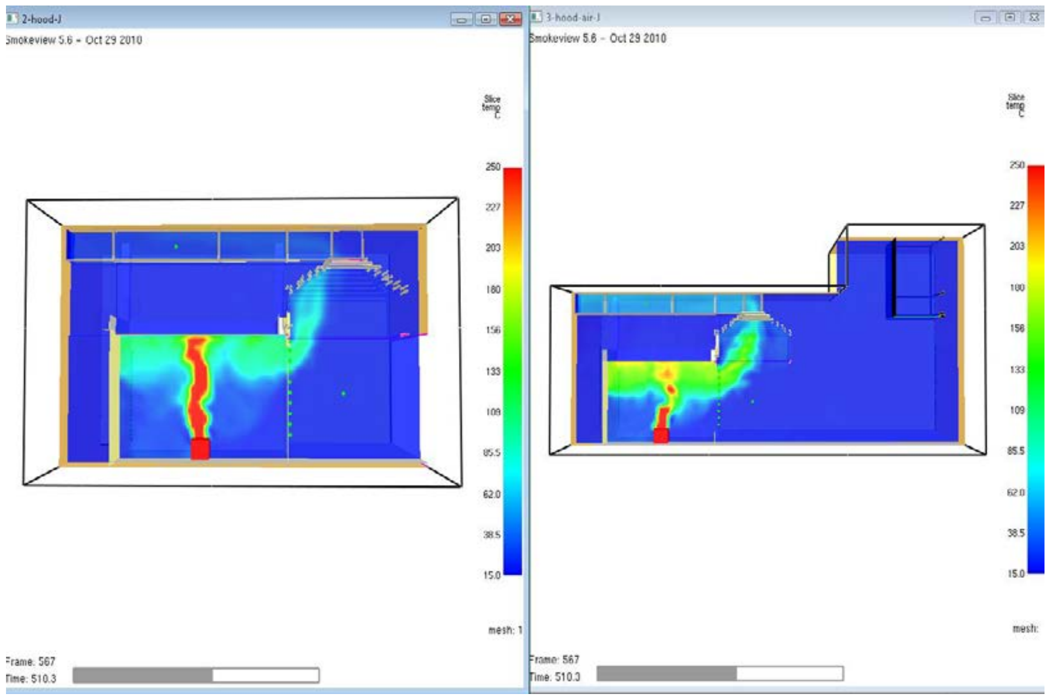

Figure 57- Temperature profiles in second & third model (FDS decreased the hood exhaust: Exp. 1)

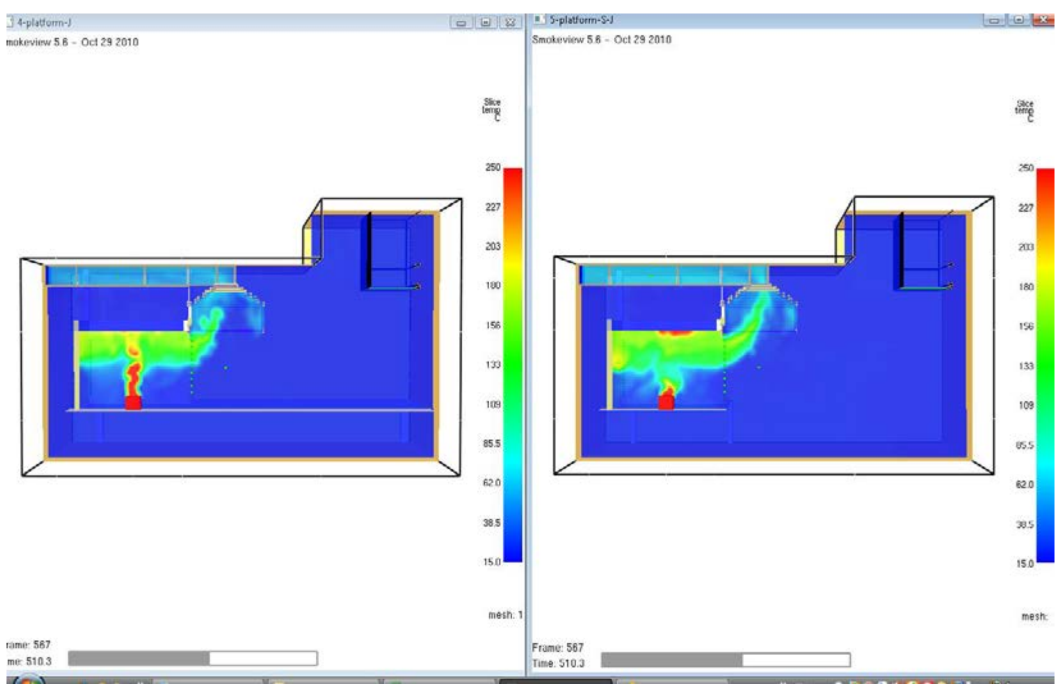

Figure 58- Temperature profiles in fourth & fifth model (FDS decreased the hood exhaust: Exp. 1)

9.1.3.2 Velocity

Velocity profiles are presented for decreasing power of the hood in the figures below.

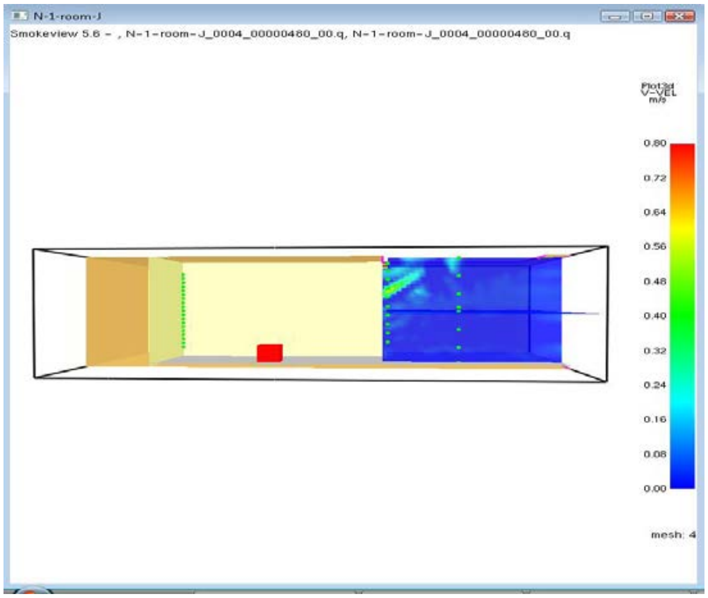

Figure 59-velocity profiles in first model (FDS decreased the hood exhaust: Exp. 1)

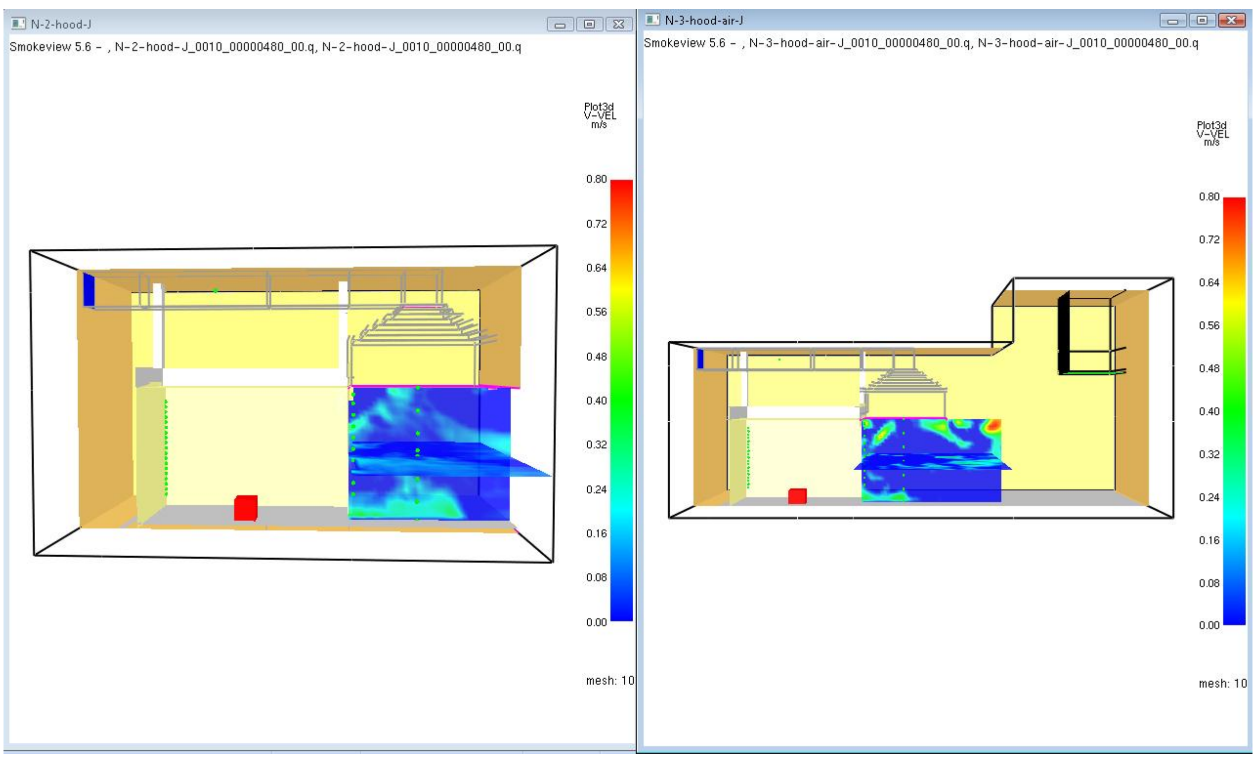

Figure 60- velocity profiles in second & third model (FDS decreased the hood exhaust: Exp. 1)

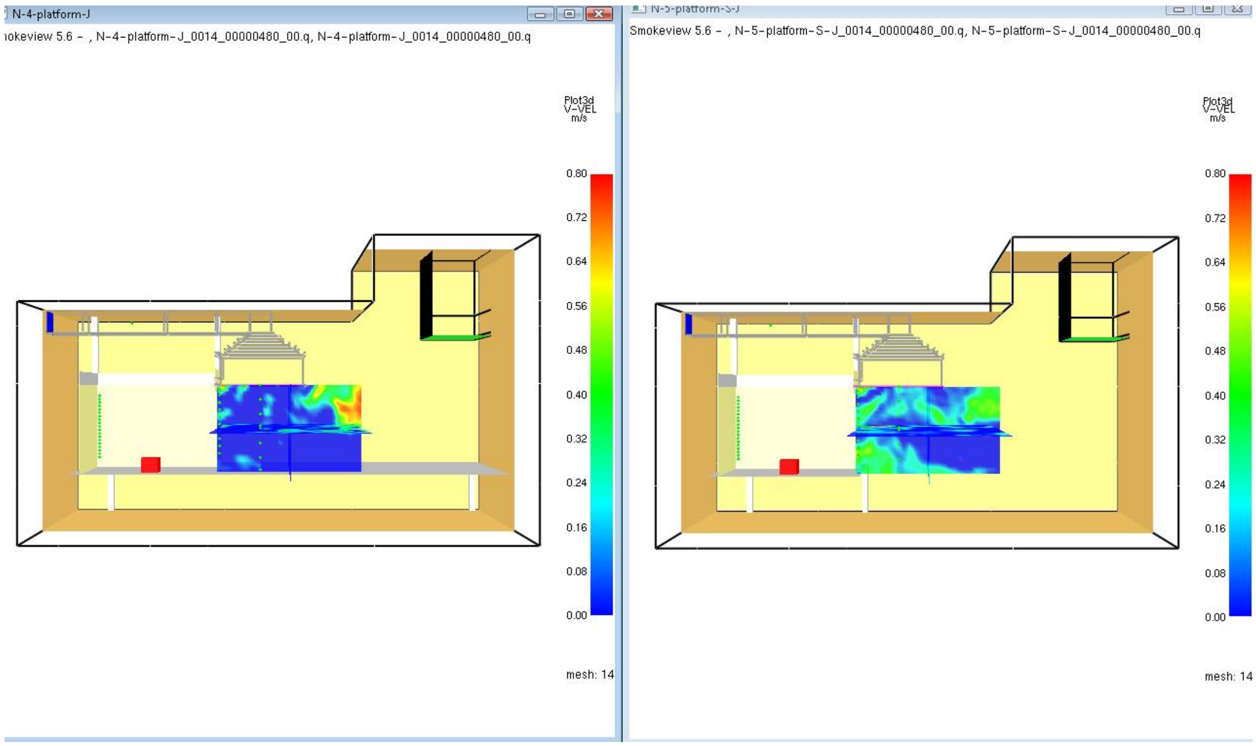

Figure 61- velocity profiles in fourth & fifth model (FDS decreased the hood exhaust: Exp. 1)

9.2 FDS-codes in simulations

9.2.1 FDS code for the first model in experiment 1:

1-room-Heptane.fds

```
&HEAD CHID='1-room-Heptane'/

&TIME T_END=900.0/

&DUMP RENDER_FILE='1-room-Heptane.ge1', DT_RESTART=300.0/

&MISC GROUND_LEVEL=-0.75, TMPA=16.0/

&MESH ID='0-1-room', FYI='Mesh-room', IJK=6,30,16, XB=-0.5,0.0,-0.6,1.9,0.0,1.2/

&MESH ID='1-1-room', FYI='Mesh-room', IJK=30,60,32, XB=0.0,1.1,-0.6,1.9,0.0,1.2/

&MESH ID='2-1-room', FYI='Mesh-room', IJK=16,60,32, XB=1.1,1.8,-0.6,1.9,0.0,1.2/

&MESH ID='3-1-hood', FYI='Mesh-hood', IJK=36,60,32, XB=1.8,3.2,-0.6,1.9,0.0,1.2/

&DEVC ID='FLOW-0ut of door', QUANTITY='MASS FLOW', XB=2.4,2.4,0.0,1.2,0.1,1.2/

&DEVC ID='THCP-inside corner-1', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.15/

&DEVC ID='THCP-inside corner-10', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.6/
```

&DEVC ID='THCP-inside corner-11', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.65/

&DEVC ID='THCP-inside corner-12', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.7/

&DEVC ID='THCP-inside corner-13', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.75/

&DEVC ID='THCP-inside corner-14', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.8/

&DEVC ID='THCP-inside corner-15', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.85/

&DEVC ID='THCP-inside corner-16', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.9/

&DEVC ID='THCP-inside corner-17', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.95/

&DEVC ID='THCP-inside corner-18', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.0/

&DEVC ID='THCP-inside corner-19', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.05/

&DEVC ID='THCP-inside corner-2', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.2/

&DEVC ID='THCP-inside corner-3', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.25/

&DEVC ID='THCP-inside corner-4', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.3/

&DEVC ID='THCP-inside corner-5', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.35/

&DEVC ID='THCP-inside corner-6', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.4/

&DEVC ID='THCP-inside corner-7', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.45/

&DEVC ID='THCP-inside corner-8', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.5/

&DEVC ID='THCP-inside corner-9', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.55/

&DEVC ID='THCP-middle of door-1', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.26/

&DEVC ID='THCP-middle of door-10', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.14/

&DEVC ID='THCP-middle of door-2', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.36/

&DEVC ID='THCP-middle of door-3', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.46/

&DEVC ID='THCP-middle of door-4', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.56/

&DEVC ID='THCP-middle of door-5', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.66/

&DEVC ID='THCP-middle of door-6', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.76/

&DEVC ID='THCP-middle of door-7', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.86/

&DEVC ID='THCP-middle of door-8', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.96/

&DEVC ID='THCP-middle of door-9', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.06/

&MATL ID='PROMATECT_H', SPECIFIC_HEAT=0.92, CONDUCTIVITY_RAMP='PROMATECT_H_CONDUCTIVITY_RAMP', DENSITY=870.0/ &RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=20.0, F=0.17/

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&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=100.0, F=0.19/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=200.0, F=0.21/

&MATL ID='STEEL',      FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',

     SPECIFIC_HEAT=0.46,      CONDUCTIVITY=45.8,      DENSITY=7850.0,      EMISSIVITY=0.95/

&SURF ID='Promatect',      COLOR='WHITE',      MATL_ID(1,1)='PROMATECT_H',
MATL_MASS_FRACTION(1,1)=1.0,      THICKNESS(1)=0.012/ & SURF ID='Steel_sheet',      COLOR='GRAY 60',
MATL_ID(1,1)='STEEL',  MATL_MASS_FRACTION(1,1)=1.0,      THICKNESS(1)=0.002/&S URF ID='Burner',
FYI='HEPTANE',      COLOR='RED',      TEXTURE_MAP='psm_fire.jpg',      HRRPUA=841.29,
RAMP_Q='Burner_RAMP_Q',      PART_ID='Fuel',      DT_INSERT=1.0/ & RAMP ID='Burner_RAMP_Q', T=0.0, F=0.0/
& RAMP ID='Burner_RAMP_Q', T=30.0, F=0.0/ & RAMP ID='Burner_RAMP_Q', T=31.0, F=1.0/ & SURF ID='Outlet',

     COLOR='BLUE',      VOLUME_FLUX=0.5969/ &OBST XB=0.0,1.8,0.0,1.2,1.22,1.24, RGB=255,255,153,
SURF_ID='Promatect'/ ceiling  &OBST XB=1.8,1.82,0.85,1.45,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/
wall-door-left

&OBST XB=1.8,1.82,-0.25,0.35,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-right

&OBST XB=1.8,1.82,-0.3,1.5,1.1,1.4, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-up

&OBST XB=0.0,1.8,0.0,0.02,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-right

&OBST XB=0.0,1.8,1.18,1.2,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-left

&OBST XB=-0.15,3.2,-0.6,1.9,0.0,0.02, COLOR='GRAY 80', SURF_ID='Promatect'/ floor

&OBST XB=0.0,0.02,0.02,1.18,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-back

&OBST XB=1.7,1.8,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-1

&OBST XB=1.7,1.8,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-2

&OBST XB=-0.1,0.0,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-3

&OBST XB=-0.1,0.0,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-4

&OBST XB=0.0,1.7,1.2,1.3,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-2

&OBST XB=0.0,1.7,-0.1,0.0,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-1

&OBST XB=-0.1,0.0,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-4

&OBST XB=1.7,1.8,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-3

&OBST XB=1.82,3.02,0.0,0.01,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side1

&OBST XB=3.01,3.02,0.0,1.2,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-front

&OBST XB=2.27,2.57,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side-

&OBST XB=2.27,2.57,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side

&OBST XB=1.82,3.02,1.2,1.21,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side2
```

&OBST XB=1.82,1.83,0.0,1.2,1.3,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-back

&OBST XB=2.57,2.57,0.45,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-front

&OBST XB=2.27,2.57,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-up

&OBST XB=-0.5,2.27,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-up

&OBST XB=-0.5,2.27,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side

&OBST XB=-0.5,2.27,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side-left

&OBST XB=-0.5,2.27,0.45,0.75,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-bottom

&OBST XB=0.8,1.0,0.5,0.7,0.02,0.22, COLOR='RED', SURF_IDS='Burner','Steel_sheet','Steel_sheet'/ burner-pan

&VENT SURF_ID='OPEN', XB=1.8,3.2,-0.6,-0.6,0.0,1.2/ Vent-1 &VENT SURF_ID='OPEN', XB=1.8,3.2,1.91,1.91,0.0,1.2/ Vent-2 &VENT SURF_ID='OPEN', XB=3.2,3.2,-0.6,1.95,0.0,1.2/ Vent-4

&VENT SURF_ID='OPEN', XB=1.8,3.02,0.0,1.2,1.2,1.2/ Vent-hood-2 &VENT SURF_ID='Outlet', XB=-0.5,-0.5,0.45,0.75,1.9,2.2/ vent-exit

&VENT SURF_ID='OPEN', XB=2.27,2.57,0.45,0.75,1.9,1.9/ Vent-hood-3-up &BNDF QUANTITY='INCIDENT HEAT FLUX'/ & BNDF QUANTITY='NORMAL VELOCITY'/ &BNDF QUANTITY='PRESSURE COEFFICIENT'/ & BNDF QUANTITY='RADIATIVE HEAT FLUX'/ &BNDF QUANTITY='RADIOMETER'/ &SLCF QUANTITY='THERMOCOUPLE', PBX=0.04/ &SLCF QUANTITY='HRRPUV', PBX=0.63/ & SLCF QUANTITY='PRESSURE', PBX=0.63/

&SLCF QUANTITY='TEMPERATURE', PBX=0.63/ & SLCF QUANTITY='U-VELOCITY', PBX=0.63/

&SLCF QUANTITY='VELOCITY', PBX=0.63/ &S LCF QUANTITY='THERMOCOUPLE', PBX=1.84/

&SLCF QUANTITY='PRESSURE', PBX=2.4/ & SLCF QUANTITY='TEMPERATURE', PBX=2.4/

&SLCF QUANTITY='U-VELOCITY', PBX=2.4/ & SLCF QUANTITY='VELOCITY', PBX=2.4/

&SLCF QUANTITY='HRRPUV', PBY=0.3/ & SLCF QUANTITY='PRESSURE', PBY=0.4/

&SLCF QUANTITY='PRESSURE ZONE', PBY=0.4/ & SLCF QUANTITY='TEMPERATURE', PBY=0.4/

&SLCF QUANTITY='V-VELOCITY', PBY=0.4/

&SLCF QUANTITY='VELOCITY', PBY=0.4/ &SLCF QUANTITY='TEMPERATURE', PBY=0.5/

&SLCF QUANTITY='V-VELOCITY', PBY=0.5/ &SLCF QUANTITY='VELOCITY', PBY=0.5/

&SLCF QUANTITY='PRESSURE', PBY=0.6/ &SLCF QUANTITY='TEMPERATURE', PBY=0.6/

&SLCF QUANTITY='THERMOCOUPLE', PBY=0.6/ &SLCF QUANTITY='V-VELOCITY', PBY=0.6/

&SLCF QUANTITY='VELOCITY', PBY=0.6/ &SLCF QUANTITY='PRESSURE', PBY=0.8/

&SLCF QUANTITY='TEMPERATURE', PBY=0.8/ & SLCF QUANTITY='PRESSURE', PBY=1.0/

&SLCF QUANTITY='TEMPERATURE', PBY=1.0/ & SLCF QUANTITY='V-VELOCITY', PBY=1.0/

&SLCF QUANTITY='VELOCITY', PBY=1.0/ & SLCF QUANTITY='THERMOCOUPLE', PBY=1.16/

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&SLCF QUANTITY='V-VELOCITY', PBY=1.2/ &SLCF QUANTITY='VELOCITY', PBY=1.2/

&SLCF QUANTITY='PRESSURE', PBZ=0.6/ & SLCF QUANTITY='TEMPERATURE', PBZ=0.6/

&SLCF QUANTITY='W-VELOCITY', PBZ=0.6/

&TAIL /
```

9.2.2 FDS code for the second model in experiment 2:

```
&HEAD CHID='2-hood-2-new'/

&TIME T_END=900.0/

&DUMP RENDER_FILE='2-hood-2-new.ge1', DT_RESTART=300.0/

&MISC GROUND_LEVEL=-0.75, TMPA=16.0/

&MESH ID='0-1-room', FYI='Mesh-room', IJK=6,30,16, XB=-0.5,0.0,-0.6,1.9,0.0,1.2/

&MESH ID='0-2-room', FYI='Mesh-room', IJK=12,60,16, XB=-0.5,0.0,-0.6,1.9,1.2,1.9/

&MESH ID='0-3-room-duct', FYI='Mesh-room', IJK=12,60,8, XB=-0.5,0.0,-0.6,1.9,1.9,2.2/

&MESH ID='1-1-room', FYI='Mesh-room', IJK=30,60,32, XB=0.0,1.1,-0.6,1.9,0.0,1.2/

&MESH ID='1-2-room', FYI='Mesh-room', IJK=15,30,8, XB=0.0,1.1,-0.6,1.9,1.2,1.9/

&MESH ID='1-3-room-duct', FYI='Mesh-room', IJK=30,60,8, XB=0.0,1.1,-0.6,1.9,1.9,2.2/

&MESH ID='2-1-room', FYI='Mesh-room', IJK=16,60,32, XB=1.1,1.8,-0.6,1.9,0.0,1.2/

&MESH ID='2-2-room', FYI='Mesh-room', IJK=8,30,8, XB=1.1,1.8,-0.6,1.9,1.2,1.9/

&MESH ID='2-3-room-duct', FYI='Mesh-room', IJK=16,60,8, XB=1.1,1.8,-0.6,1.9,1.9,2.2/

&MESH ID='3-1-hood', FYI='Mesh-hood', IJK=36,60,32, XB=1.8,3.2,-0.6,1.9,0.0,1.2/

&MESH ID='3-2-hood', FYI='Mesh-hood', IJK=36,60,16, XB=1.8,3.2,-0.6,1.9,1.2,1.9/

&MESH ID='3-3-hood', FYI='Mesh-hood', IJK=36,60,8, XB=1.8,3.2,-0.6,1.9,1.9,2.2/

&DEVC ID='FLOW-0ut of door', QUANTITY='MASS FLOW', XB=2.4,2.4,0.0,1.2,0.1,1.2/

&DEVC ID='FLOW-duct', QUANTITY='MASS FLOW', XB=0.63,0.63,0.45,0.75,1.9,2.2/

&DEVC ID='GAS-P', QUANTITY='PRESSURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-T', QUANTITY='TEMPERATURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-V', QUANTITY='VELOCITY', XYZ=0.63,0.6,2.05/

&DEVC ID='THCP-inside corner-1', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.15/

&DEVC ID='THCP-inside corner-10', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.6/

&DEVC ID='THCP-inside corner-11', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.65/
```

```
&DEVC ID='THCP-inside corner-12', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.7/

&DEVC ID='THCP-inside corner-13', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.75/

&DEVC ID='THCP-inside corner-14', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.8/

&DEVC ID='THCP-inside corner-15', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.85/

&DEVC ID='THCP-inside corner-16', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.9/

&DEVC ID='THCP-inside corner-17', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.95/

&DEVC ID='THCP-inside corner-18', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.0/

&DEVC ID='THCP-inside corner-19', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.05/

&DEVC ID='THCP-inside corner-2', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.2/

&DEVC ID='THCP-inside corner-3', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.25/

&DEVC ID='THCP-inside corner-4', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.3/

&DEVC ID='THCP-inside corner-5', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.35/

&DEVC ID='THCP-inside corner-6', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.4/

&DEVC ID='THCP-inside corner-7', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.45/

&DEVC ID='THCP-inside corner-8', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.5/

&DEVC ID='THCP-inside corner-9', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.55/

&DEVC ID='THCP-middle of door-1', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.26/

&DEVC ID='THCP-middle of door-10', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.14/

&DEVC ID='THCP-middle of door-2', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.36/

&DEVC ID='THCP-middle of door-3', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.46/

&DEVC ID='THCP-middle of door-4', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.56/

&DEVC ID='THCP-middle of door-5', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.66/

&DEVC ID='THCP-middle of door-6', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.76/

&DEVC ID='THCP-middle of door-7', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.86/

&DEVC ID='THCP-middle of door-8', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.96/

&DEVC ID='THCP-middle of door-9', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.06/

&MATL ID='PROMATECT_H', SPECIFIC_HEAT=0.92,
CONDUCTIVITY_RAMP='PROMATECT_H_CONDUCTIVITY_RAMP',      DENSITY=870.0/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=20.0, F=0.17/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=100.0, F=0.19/
```

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&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=200.0, F=0.21/

&MATL ID='STEEL',    FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',

    SPECIFIC_HEAT=0.46,    CONDUCTIVITY=45.8,    DENSITY=7850.0,    EMISSIVITY=0.95/

&SURF ID='Promatect',    COLOR='WHITE',  MATL_ID(1,1)='PROMATECT_H',    MATL_MASS_FRACTION(1,1)=1.0,

    THICKNESS(1)=0.012/ &SURF ID='Steel_sheet',    COLOR='GRAY 60',

    MATL_ID(1,1)='STEEL',    MATL_MASS_FRACTION(1,1)=1.0,    THICKNESS(1)=0.002/

&SURF ID='Burner',    FYI='HEPTANE',    COLOR='RED',    TEXTURE_MAP='psm_fire.jpg',    HRRPUA=928.51,

    RAMP_Q='Burner_RAMP_Q',    PART_ID='Fuel',    DT_INSERT=1.0/ &RAMP ID='Burner_RAMP_Q', T=0.0,
F=0.0/ &RAMP ID='Burner_RAMP_Q', T=30.0, F=0.0/ &RAMP ID='Burner_RAMP_Q', T=31.0, F=1.0/ &SURF
ID='Outlet',    COLOR='BLUE',    VOLUME_FLUX=0.5969/

&OBST XB=0.0,1.8,0.0,1.2,1.22,1.24, RGB=255,255,153, SURF_ID='Promatect'/ ceilling

&OBST XB=1.8,1.82,0.85,1.45,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-left

&OBST XB=1.8,1.82,-0.25,0.35,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-right

&OBST XB=1.8,1.82,-0.3,1.5,1.1,1.4, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-up

&OBST XB=0.0,1.8,0.0,0.02,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-right

&OBST XB=0.0,1.8,1.18,1.2,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-left

&OBST XB=-0.15,3.2,-0.6,1.9,0.0,0.02, COLOR='GRAY 80', SURF_ID='Promatect'/ floor

&OBST XB=0.0,0.02,0.02,1.18,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-back

&OBST XB=1.7,1.8,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-1

&OBST XB=1.7,1.8,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-2

&OBST XB=-0.1,0.0,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-3

&OBST XB=-0.1,0.0,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-4

&OBST XB=0.0,1.7,1.2,1.3,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-2

&OBST XB=0.0,1.7,-0.1,0.0,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-1

&OBST XB=-0.1,0.0,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-4

&OBST XB=1.7,1.8,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-3

&OBST XB=1.82,3.02,0.0,0.01,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side1

&OBST XB=3.01,3.02,0.0,1.2,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-front

&OBST XB=2.27,2.57,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side-

&OBST XB=2.27,2.57,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side
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&OBST XB=1.82,3.02,1.2,1.21,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side2

&OBST XB=1.82,1.83,0.0,1.2,1.3,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-back

&OBST XB=2.57,2.57,0.45,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-front

&OBST XB=2.27,2.57,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-up

&OBST XB=-0.5,2.27,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-up

&OBST XB=-0.5,2.27,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side

&OBST XB=-0.5,2.27,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side-left

&OBST XB=-0.5,2.27,0.45,0.75,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-bottom

&OBST XB=0.8,1.0,0.5,0.7,0.02,0.22, COLOR='RED', SURF_IDS='Burner','Steel_sheet','Steel_sheet'/ burner-pan

&OBST XB=1.83889,1.87778,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.83889,1.87778,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.83889,1.91667,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.91667,1.95556,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.95556,1.99444,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.95556,2.03333,0.191667,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.03333,2.07222,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.03333,2.07222,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.03333,2.11111,0.275,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.11111,2.15,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.11111,2.15,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.11111,2.18889,0.358333,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.18889,2.22778,0.4,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.22778,2.26667,0.441667,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/
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&OBST XB=1.83889,1.83889,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.91667,1.91667,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.95556,1.95556,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.03333,2.03333,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.11111,2.11111,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.18889,2.18889,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.22778,2.22778,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.83889,3.00556,-0.0166667,0.025,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.87778,2.96667,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.91667,2.92778,0.0666667,0.108333,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.95556,2.88889,0.108333,0.15,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.99444,2.85,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.03333,2.81111,0.191667,0.233333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.07222,2.77222,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.11111,2.73333,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.15,2.69444,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.18889,2.65556,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.22778,2.61667,0.4,0.441667,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.83889,3.00556,0.025,0.025,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.91667,2.92778,0.108333,0.108333,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.95556,2.85,0.15,0.15,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.03333,2.81111,0.233333,0.233333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.11111,2.73333,0.275,0.275,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.18889,2.65556,0.358333,0.358333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.22778,2.61667,0.4,0.4,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.83889,3.00556,1.15,1.19167,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.87778,2.96667,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.91667,2.88889,1.06667,1.10833,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.95556,2.85,1.025,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.03333,2.81111,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.07222,2.77222,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.11111,2.73333,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.15,2.69444,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.18889,2.65556,0.816667,0.858333,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.22778,2.61667,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.26667,2.57778,0.733333,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.83889,3.00556,1.19167,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.91667,2.92778,1.10833,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.95556,2.85,1.025,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.03333,2.81111,0.983333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.11111,2.73333,0.9,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.18889,2.65556,0.858333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.22778,2.61667,0.775,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.57778,2.61667,0.441667,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.61667,2.65556,0.4,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.65556,2.73333,0.358333,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.69444,2.73333,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.69444,2.73333,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.73333,2.81111,0.275,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.77222,2.81111,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.77222,2.81111,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.81111,2.85,0.191667,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.85,2.92778,0.15,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.88889,2.92778,0.108333,0.15,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.88889,2.92778,1.06667,1.10833,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.92778,3.00556,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00556,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00556,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.61667,2.61667,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.65556,2.65556,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.73333,2.73333,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.81111,2.81111,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.85,2.85,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=2.92778,2.92778,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=3.00556,3.00556,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&VENT SURF_ID='OPEN', XB=1.8,3.02,0.0,1.2,1.2,1.2/ Vent-hood-2

&VENT SURF_ID='Outlet', XB=-0.5,-0.5,0.45,0.75,1.9,2.2/ vent-exit

&VENT SURF_ID='OPEN', XB=2.27,2.57,0.45,0.75,1.9,1.9/ Vent-hood-3-up

&BNDF QUANTITY='INCIDENT HEAT FLUX'/ &BNDF QUANTITY='NORMAL VELOCITY'/

&BNDF QUANTITY='PRESSURE COEFFICIENT'/ &BNDF QUANTITY='RADIATIVE HEAT FLUX'/

&BNDF QUANTITY='RADIOMETER'/ &SLCF QUANTITY='THERMOCOUPLE', PBX=0.04/ &SLCF QUANTITY='HRRPUV', PBX=0.63/ &SLCF QUANTITY='PRESSURE', PBX=0.63/ &SLCF QUANTITY='TEMPERATURE', PBX=0.63/

&SLCF QUANTITY='U-VELOCITY', PBX=0.63/ &SLCF QUANTITY='VELOCITY', PBX=0.63/

&SLCF QUANTITY='THERMOCOUPLE', PBX=1.84/ &SLCF QUANTITY='PRESSURE', PBX=2.4/

&SLCF QUANTITY='TEMPERATURE', PBX=2.4/ &SLCF QUANTITY='U-VELOCITY', PBX=2.4/

&SLCF QUANTITY='VELOCITY', PBX=2.4/ &SLCF QUANTITY='HRRPUV', PBY=0.3/

&SLCF QUANTITY='PRESSURE', PBY=0.4/ &SLCF QUANTITY='PRESSURE ZONE', PBY=0.4/

&SLCF QUANTITY='TEMPERATURE', PBY=0.4/ &SLCF QUANTITY='V-VELOCITY', PBY=0.4/

&SLCF QUANTITY='VELOCITY', PBY=0.4/ &SLCF QUANTITY='TEMPERATURE', PBY=0.5/

&SLCF QUANTITY='V-VELOCITY', PBY=0.5/ &SLCF QUANTITY='VELOCITY', PBY=0.5/

&SLCF QUANTITY='PRESSURE', PBY=0.6/ &SLCF QUANTITY='TEMPERATURE', PBY=0.6/

&SLCF QUANTITY='THERMOCOUPLE', PBY=0.6/ &SLCF QUANTITY='V-VELOCITY', PBY=0.6/

&SLCF QUANTITY='VELOCITY', PBY=0.6/ &SLCF QUANTITY='PRESSURE', PBY=0.8/

&SLCF QUANTITY='TEMPERATURE', PBY=0.8/ &SLCF QUANTITY='PRESSURE', PBY=1.0/

&SLCF QUANTITY='TEMPERATURE', PBY=1.0/ &SLCF QUANTITY='V-VELOCITY', PBY=1.0/

&SLCF QUANTITY='VELOCITY', PBY=1.0/ &SLCF QUANTITY='THERMOCOUPLE', PBY=1.16/

&SLCF QUANTITY='V-VELOCITY', PBY=1.2/ &SLCF QUANTITY='VELOCITY', PBY=1.2/

&SLCF QUANTITY='PRESSURE', PBZ=0.6/ &SLCF QUANTITY='TEMPERATURE', PBZ=0.6/

&SLCF QUANTITY='W-VELOCITY', PBZ=0.6/

&TAIL /

9.2.3 FDS code for the third model in experiment 1:

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&HEAD CHID='3-hood-air-Heptane'/

&TIME T_END=900.0/

&DUMP RENDER_FILE='3-hood-air-Heptane.ge1', DT_RESTART=300.0/

&MISC GROUND_LEVEL=-0.75, TMPA=16.0/

&MESH ID='0-1-room', FYI='Mesh-room', IJK=6,30,12, XB=-0.5,0.0,-0.6,1.9,0.0,1.2/

&MESH ID='0-2-room', FYI='Mesh-room', IJK=6,30,8, XB=-0.5,0.0,-0.6,1.9,1.2,1.9/

&MESH ID='0-3-room-duct', FYI='Mesh-room', IJK=12,60,8, XB=-0.5,0.0,-0.6,1.9,1.9,2.2/

&MESH ID='1-1-room', FYI='Mesh-room', IJK=24,60,24, XB=0.0,1.1,-0.6,1.9,0.0,1.2/

&MESH ID='1-2-room', FYI='Mesh-room', IJK=12,30,8, XB=0.0,1.1,-0.6,1.9,1.2,1.9/

&MESH ID='1-3-room-duct', FYI='Mesh-room', IJK=24,60,8, XB=0.0,1.1,-0.6,1.9,1.9,2.2/

&MESH ID='2-1-room', FYI='Mesh-room', IJK=16,60,24, XB=1.1,1.8,-0.6,1.9,0.0,1.2/

&MESH ID='2-2-room', FYI='Mesh-room', IJK=8,30,8, XB=1.1,1.8,-0.6,1.9,1.2,1.9/

&MESH ID='2-3-room-duct', FYI='Mesh-room', IJK=16,60,8, XB=1.1,1.8,-0.6,1.9,1.9,2.2/

&MESH ID='3-1-hood', FYI='Mesh-hood', IJK=48,60,24, XB=1.8,3.8,-0.6,1.9,0.0,1.2/

&MESH ID='3-2-hood', FYI='Mesh-hood', IJK=48,60,16, XB=1.8,3.8,-0.6,1.9,1.2,1.9/

&MESH ID='3-3-hood', FYI='Mesh-hood', IJK=48,60,8, XB=1.8,3.8,-0.6,1.9,1.9,2.2/

&MESH ID='4-1-air', IJK=44,60,24, XB=3.8,5.8,-0.6,1.9,0.0,1.2/ &MESH ID='4-2-air', IJK=44,60,16, XB=3.8,5.8,-
0.6,1.9,1.2,1.9/

&MESH ID='4-3-air', IJK=44,60,8, XB=3.8,5.8,-0.6,1.9,1.9,2.2/ &MESH ID='4-4-air', IJK=44,60,20, XB=3.8,5.8,-
0.6,1.9,2.2,3.0/

&DEVC ID='FLOW-0ut of door', QUANTITY='MASS FLOW', XB=2.4,2.4,0.0,1.2,0.1,1.1/

&DEVC ID='FLOW-duct', QUANTITY='MASS FLOW', XB=0.63,0.63,0.45,0.75,1.9,2.2/

&DEVC ID='GAS-P', QUANTITY='PRESSURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-T', QUANTITY='TEMPERATURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-V', QUANTITY='VELOCITY', XYZ=0.63,0.6,2.05/

&DEVC ID='THCP-inside corner-1', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.15/

&DEVC ID='THCP-inside corner-10', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.6/

&DEVC ID='THCP-inside corner-11', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.65/
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&DEVC ID='THCP-inside corner-12', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.7/

&DEVC ID='THCP-inside corner-13', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.75/

&DEVC ID='THCP-inside corner-14', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.8/

&DEVC ID='THCP-inside corner-15', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.85/

&DEVC ID='THCP-inside corner-16', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.9/

&DEVC ID='THCP-inside corner-17', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.95/

&DEVC ID='THCP-inside corner-18', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.0/

&DEVC ID='THCP-inside corner-19', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.05/

&DEVC ID='THCP-inside corner-2', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.2/

&DEVC ID='THCP-inside corner-3', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.25/

&DEVC ID='THCP-inside corner-4', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.3/

&DEVC ID='THCP-inside corner-5', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.35/

&DEVC ID='THCP-inside corner-6', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.4/

&DEVC ID='THCP-inside corner-7', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.45/

&DEVC ID='THCP-inside corner-8', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.5/

&DEVC ID='THCP-inside corner-9', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.55/

&DEVC ID='THCP-middle of door-1', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.26/

&DEVC ID='THCP-middle of door-10', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.14/

&DEVC ID='THCP-middle of door-2', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.36/

&DEVC ID='THCP-middle of door-3', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.46/

&DEVC ID='THCP-middle of door-4', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.56/

&DEVC ID='THCP-middle of door-5', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.66/

&DEVC ID='THCP-middle of door-6', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.76/

&DEVC ID='THCP-middle of door-7', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.86/

&DEVC ID='THCP-middle of door-8', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.96/

&DEVC ID='THCP-middle of door-9', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.06/

&MATL ID='PROMATECT_H',      SPECIFIC_HEAT=0.92,
CONDUCTIVITY_RAMP='PROMATECT_H_CONDUCTIVITY_RAMP',      DENSITY=870.0/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=20.0, F=0.17/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=100.0, F=0.19/
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&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=200.0, F=0.21/

&MATL ID='STEEL',      FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',

     SPECIFIC_HEAT=0.46,      CONDUCTIVITY=45.8,      DENSITY=7850.0,      EMISSIVITY=0.95/&SURF ID='Promatect',

     COLOR='WHITE',      MATL_ID(1,1)='PROMATECT_H',      MATL_MASS_FRACTION(1,1)=1.0,
THICKNESS(1)=0.012/ &SURF ID='Steel_sheet',      COLOR='GRAY 60',      MATL_ID(1,1)='STEEL',

     MATL_MASS_FRACTION(1,1)=1.0,      THICKNESS(1)=0.002/      &SURF   ID='Burner',      FYI='HEPTANE',
COLOR='RED',      TEXTURE_MAP='psm_fire.jpg',      HRRPUA=841.29,      RAMP_Q='Burner_RAMP_Q',

     PART_ID='Fuel',      DT_INSERT=1.0/ &RAMP ID='Burner_RAMP_Q', T=0.0, F=0.0/

&RAMP ID='Burner_RAMP_Q', T=30.0, F=0.0/ &RAMP ID='Burner_RAMP_Q', T=31.0, F=1.0/

&SURF  ID='entrance',      RGB=51,255,51,      VOLUME_FLUX=-1.209/  &SURF  ID='Outlet',      COLOR='BLUE',
VOLUME_FLUX=0.5969/ &OBST XB=0.0,1.8,0.0,1.2,1.22,1.24, RGB=255,255,153, SURF_ID='Promatect'/ ceilling

&OBST XB=1.8,1.82,0.85,1.45,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-left

&OBST XB=1.8,1.82,-0.25,0.35,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-right

&OBST XB=1.8,1.82,-0.3,1.5,1.1,1.4, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-up

&OBST XB=0.0,1.8,0.0,0.02,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-right

&OBST XB=0.0,1.8,1.18,1.2,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-left

&OBST XB=-0.15,5.75,-0.6,1.9,0.0,0.02, COLOR='GRAY 80', SURF_ID='Promatect'/ floor

&OBST XB=0.0,0.02,0.02,1.18,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-back

&OBST XB=1.7,1.8,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-1

&OBST XB=1.7,1.8,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-2

&OBST XB=-0.1,0.0,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-3

&OBST XB=-0.1,0.0,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-4

&OBST XB=0.0,1.7,1.2,1.3,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-2

&OBST XB=0.0,1.7,-0.1,0.0,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-1

&OBST XB=-0.1,0.0,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-4

&OBST XB=1.7,1.8,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-3

&OBST XB=1.82,3.02,0.0,0.01,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side1

&OBST XB=3.01,3.02,0.0,1.2,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-front

&OBST XB=2.27,2.57,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side-

&OBST XB=2.27,2.57,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side
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&OBST XB=1.82,3.02,1.2,1.21,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side2

&OBST XB=1.82,1.83,0.0,1.2,1.3,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-back

&OBST XB=2.57,2.57,0.45,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-front

&OBST XB=2.27,2.57,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-up

&OBST XB=-0.5,2.27,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-up

&OBST XB=-0.5,2.27,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side

&OBST XB=-0.5,2.27,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side-left

&OBST XB=-0.5,2.27,0.45,0.75,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-bottom

&OBST XB=0.8,1.0,0.5,0.7,0.02,0.22, COLOR='RED', SURF_IDS='Burner','Steel_sheet','Steel_sheet'/ burner-pan

&OBST XB=4.73,5.48,0.12,1.05,1.86,1.86, SURF_ID='entrance'/ air-entrance

&OBST XB=4.73,4.73,0.12,1.08,1.86,3.06, COLOR='BLACK', SURF_ID='Steel_sheet'/ plate-1

&OBST XB=5.48,5.48,0.12,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-2

&OBST XB=4.73,5.48,1.08,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-3

&OBST XB=4.73,5.48,0.12,0.12,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-4

&OBST XB=1.8,1.84167,-0.0166667,1.19167,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.925,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.96667,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.05,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.09167,0.233333,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.175,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.21667,0.358333,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.25833,0.4,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.84167,1.84167,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,1.96667,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.05,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.09167,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.175,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.21667,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,-0.0166667,0.025,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.88333,2.96667,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.0666667,0.108333,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.108333,0.15,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.00833,2.84167,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.05,2.8,0.191667,0.233333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.09167,2.75833,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.13333,2.71667,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.63333,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.25833,2.59167,0.4,0.441667,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,0.025,0.025,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.108333,0.108333,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.15,0.15,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.05,2.8,0.233333,0.233333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.09167,2.71667,0.275,0.275,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.358333,0.358333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.59167,0.4,0.4,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.84167,3.00833,1.15,1.19167,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.88333,2.96667,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.06667,1.10833,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.00833,2.84167,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.75833,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.13333,2.71667,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.175,2.675,0.816667,0.858333,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.63333,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.25833,2.59167,0.733333,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,1.19167,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.10833,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.983333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.71667,0.9,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.175,2.675,0.858333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.59167,0.775,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.55,2.59167,0.441667,0.733333,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.59167,2.675,0.4,0.775,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.63333,2.675,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.63333,2.675,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.675,2.71667,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.71667,2.8,0.275,0.9,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.75833,2.8,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.75833,2.8,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.8,2.88333,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.88333,2.925,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,3.00833,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

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&OBST XB=2.96667,3.00833,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00833,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.59167,2.59167,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.675,2.675,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.71667,2.71667,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.8,2.8,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.88333,2.88333,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,2.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=3.00833,3.00833,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&VENT SURF_ID='OPEN', XB=4.7,5.48,0.12,1.08,3.06,3.06/ Vent-5

&VENT SURF_ID='OPEN', XB=1.8,3.02,0.0,1.2,1.2,1.2/ Vent-hood-2

&VENT SURF_ID='Outlet', XB=-0.5,-0.5,0.45,0.75,1.9,2.2/ vent-exit

&VENT SURF_ID='OPEN', XB=2.27,2.57,0.45,0.75,1.9,1.9/ Vent-hood-3-up

&BNDF QUANTITY='INCIDENT HEAT FLUX'/ &BNDF QUANTITY='NORMAL VELOCITY'/

&BNDF QUANTITY='PRESSURE COEFFICIENT'/ &BNDF QUANTITY='RADIATIVE HEAT FLUX'/

&BNDF QUANTITY='RADIOMETER'/ &SLCF QUANTITY='THERMOCOUPLE', PBX=0.04/

&SLCF QUANTITY='HRRPUV', PBX=0.63/ &SLCF QUANTITY='PRESSURE', PBX=0.63/

&SLCF QUANTITY='TEMPERATURE', PBX=0.63/ &SLCF QUANTITY='U-VELOCITY', PBX=0.63/

&SLCF QUANTITY='VELOCITY', PBX=0.63/ &SLCF QUANTITY='THERMOCOUPLE', PBX=1.84/

&SLCF QUANTITY='PRESSURE', PBX=2.4/ &SLCF QUANTITY='TEMPERATURE', PBX=2.4/

&SLCF QUANTITY='U-VELOCITY', PBX=2.4/ &SLCF QUANTITY='VELOCITY', PBX=2.4/

&SLCF QUANTITY='PRESSURE', PBX=5.1/ &SLCF QUANTITY='TEMPERATURE', PBX=5.1/

&SLCF QUANTITY='U-VELOCITY', PBX=5.1/ &SLCF QUANTITY='VELOCITY', PBX=5.1/

&SLCF QUANTITY='HRRPUV', PBY=0.3/ &SLCF QUANTITY='PRESSURE', PBY=0.4/

&SLCF QUANTITY='PRESSURE ZONE', PBY=0.4/ &SLCF QUANTITY='TEMPERATURE', PBY=0.4/
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&SLCF QUANTITY='V-VELOCITY', PBY=0.4/ &SLCF QUANTITY='VELOCITY', PBY=0.4/

&SLCF QUANTITY='TEMPERATURE', PBY=0.5/ &SLCF QUANTITY='V-VELOCITY', PBY=0.5/

&SLCF QUANTITY='VELOCITY', PBY=0.5/ &SLCF QUANTITY='PRESSURE', PBY=0.6/

&SLCF QUANTITY='TEMPERATURE', PBY=0.6/

&SLCF QUANTITY='THERMOCOUPLE', PBY=0.6/ &SLCF QUANTITY='V-VELOCITY', PBY=0.6/

&SLCF QUANTITY='VELOCITY', PBY=0.6/  &SLCF QUANTITY='PRESSURE', PBY=0.8/

&SLCF QUANTITY='TEMPERATURE', PBY=0.8/  &SLCF QUANTITY='PRESSURE', PBY=1.0/

&SLCF QUANTITY='TEMPERATURE', PBY=1.0/ &SLCF QUANTITY='V-VELOCITY', PBY=1.0/

&SLCF QUANTITY='VELOCITY', PBY=1.0/ &SLCF QUANTITY='THERMOCOUPLE', PBY=1.16/

&SLCF QUANTITY='V-VELOCITY', PBY=1.2/ &SLCF QUANTITY='VELOCITY', PBY=1.2/

&SLCF QUANTITY='PRESSURE', PBZ=0.6/ &SLCF QUANTITY='TEMPERATURE', PBZ=0.6/

&SLCF QUANTITY='W-VELOCITY', PBZ=0.6/

&TAIL /
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9.2.4 FDS code for the forth model in experiment 1:

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&HEAD CHID='4-platform-experiment 1'/

&TIME T_END=900.0/

&DUMP RENDER_FILE='4-platform-Heptane.ge1', DT_RESTART=300.0/

&MISC GROUND_LEVEL=-0.75, TMPA=16.0/

&MESH ID='0-0-room', FYI='Mesh-room', IJK=6,30,9, XB=-0.5,0.0,-0.6,1.9,-0.75,0.0/

&MESH ID='0-1-room', FYI='Mesh-room', IJK=6,30,12, XB=-0.5,0.0,-0.6,1.9,0.0,1.2/

&MESH ID='0-2-room', FYI='Mesh-room', IJK=6,30,8, XB=-0.5,0.0,-0.6,1.9,1.2,1.9/

&MESH ID='0-3-room-duct', FYI='Mesh-room', IJK=12,60,8, XB=-0.5,0.0,-0.6,1.9,1.9,2.2/

&MESH ID='1-1-room', FYI='Mesh-room', IJK=12,30,9, XB=0.0,1.1,-0.6,1.9,-0.75,0.0/

&MESH ID='1-2-room', FYI='Mesh-room', IJK=24,60,24, XB=0.0,1.1,-0.6,1.9,0.0,1.2/

&MESH ID='1-3-room', FYI='Mesh-room', IJK=12,30,8, XB=0.0,1.1,-0.6,1.9,1.2,1.9/

&MESH ID='1-4-room-duct', FYI='Mesh-room', IJK=24,60,8, XB=0.0,1.1,-0.6,1.9,1.9,2.2/

&MESH ID='2-0-room', FYI='Mesh-room', IJK=8,30,9, XB=1.1,1.8,-0.6,1.9,-0.75,0.0/

&MESH ID='2-1-room', FYI='Mesh-room', IJK=16,60,24, XB=1.1,1.8,-0.6,1.9,0.0,1.2/

&MESH ID='2-2-room', FYI='Mesh-room', IJK=8,30,8, XB=1.1,1.8,-0.6,1.9,1.2,1.9/
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&MESH ID='2-3-room-duct', FYI='Mesh-room', IJK=16,60,8, XB=1.1,1.8,-0.6,1.9,1.9,2.2/

&MESH ID='3-0-hood', FYI='Mesh-hood', IJK=24,30,9, XB=1.8,3.8,-0.6,1.9,-0.75,0.0/

&MESH ID='3-1-hood', FYI='Mesh-hood', IJK=48,60,24, XB=1.8,3.8,-0.6,1.9,0.0,1.2/

&MESH ID='3-2-hood', FYI='Mesh-hood', IJK=48,60,16, XB=1.8,3.8,-0.6,1.9,1.2,1.9/

&MESH ID='3-3-hood', FYI='Mesh-hood', IJK=48,60,8, XB=1.8,3.8,-0.6,1.9,1.9,2.2/

&MESH ID='4-0-air', IJK=22,30,9, XB=3.8,5.8,-0.6,1.9,-0.75,0.0/

&MESH ID='4-1-air', IJK=44,60,24, XB=3.8,5.8,-0.6,1.9,0.0,1.2/ &MESH ID='4-2-air', IJK=44,60,16, XB=3.8,5.8,-
0.6,1.9,1.2,1.9/ &MESH ID='4-3-air', IJK=44,60,8, XB=3.8,5.8,-0.6,1.9,1.9,2.2/ &MESH ID='4-4-air', IJK=44,60,20,
XB=3.8,5.8,-0.6,1.9,2.2,3.0/

&DEVC ID='FLOW-0ut of door', QUANTITY='MASS FLOW', XB=2.4,2.4,0.0,1.2,0.1,1.18/

&DEVC ID='FLOW-duct', QUANTITY='MASS FLOW', XB=0.63,0.63,0.45,0.75,1.9,2.2/

&DEVC ID='GAS-P', QUANTITY='PRESSURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-T', QUANTITY='TEMPERATURE', XYZ=0.63,0.6,2.05/

&DEVC ID='GAS-V', QUANTITY='VELOCITY', XYZ=0.63,0.6,2.05/

&DEVC ID='THCP-inside corner-1', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.15/

&DEVC ID='THCP-inside corner-10', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.6/

&DEVC ID='THCP-inside corner-11', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.65/

&DEVC ID='THCP-inside corner-12', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.7/

&DEVC ID='THCP-inside corner-13', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.75/

&DEVC ID='THCP-inside corner-14', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.8/

&DEVC ID='THCP-inside corner-15', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.85/

&DEVC ID='THCP-inside corner-16', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.9/

&DEVC ID='THCP-inside corner-17', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.95/

&DEVC ID='THCP-inside corner-18', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.0/

&DEVC ID='THCP-inside corner-19', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.05/

&DEVC ID='THCP-inside corner-2', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.2/

&DEVC ID='THCP-inside corner-3', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.25/

&DEVC ID='THCP-inside corner-4', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.3/

&DEVC ID='THCP-inside corner-5', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.35/

&DEVC ID='THCP-inside corner-6', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.4/
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&DEVC ID='THCP-inside corner-7', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.45/

&DEVC ID='THCP-inside corner-8', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.5/

&DEVC ID='THCP-inside corner-9', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.55/

&DEVC ID='THCP-middle of door-1', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.26/

&DEVC ID='THCP-middle of door-10', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.14/

&DEVC ID='THCP-middle of door-2', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.36/

&DEVC ID='THCP-middle of door-3', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.46/

&DEVC ID='THCP-middle of door-4', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.56/

&DEVC ID='THCP-middle of door-5', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.66/

&DEVC ID='THCP-middle of door-6', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.76/

&DEVC ID='THCP-middle of door-7', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.86/

&DEVC ID='THCP-middle of door-8', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.96/

&DEVC ID='THCP-middle of door-9', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.06/

&MATL ID='PROMATECT_H', SPECIFIC_HEAT=0.92,
CONDUCTIVITY_RAMP='PROMATECT_H_CONDUCTIVITY_RAMP',      DENSITY=870.0/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=20.0, F=0.17/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=100.0, F=0.19/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=200.0, F=0.21/

&MATL ID='STEEL',      FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',

    SPECIFIC_HEAT=0.46,      CONDUCTIVITY=45.8,      DENSITY=7850.0,      EMISSIVITY=0.95/

&SURF ID='Promatect',      COLOR='WHITE',      MATL_ID(1,1)='PROMATECT_H',

    MATL_MASS_FRACTION(1,1)=1.0,      THICKNESS(1)=0.012/

&SURF  ID='Steel_sheet',        COLOR='GRAY 60',        MATL_ID(1,1)='STEEL',        MATL_MASS_FRACTION(1,1)=1.0,
THICKNESS(1)=0.002/

&SURF ID='Burner',      FYI='HEPTANE',      COLOR='RED',      TEXTURE_MAP='psm_fire.jpg',      HRRPUA=841.29,

    RAMP_Q='Burner_RAMP_Q',      PART_ID='Fuel',      DT_INSERT=1.0/

&RAMP ID='Burner_RAMP_Q', T=0.0, F=0.0/ &RAMP ID='Burner_RAMP_Q', T=30.0, F=0.0/

&RAMP ID='Burner_RAMP_Q', T=31.0, F=1.0/ &SURF ID='entrance',      RGB=51,255,51,      VOLUME_FLUX=-1.209/

&SURF ID='Outlet',      COLOR='BLUE',      VOLUME_FLUX=0.5969/

&OBST XB=0.0,1.8,0.0,1.2,1.22,1.24, RGB=255,255,153, SURF_ID='Promatect'/ ceilling
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&OBST XB=1.8,1.82,0.85,1.45,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-left
&OBST XB=1.8,1.82,-0.25,0.35,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-right
&OBST XB=1.8,1.82,-0.3,1.5,1.1,1.4, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-up
&OBST XB=0.0,1.8,0.0,0.02,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-right
&OBST XB=0.0,1.8,1.18,1.2,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-left
&OBST XB=-0.15,5.75,-0.6,1.9,0.0,0.02, COLOR='GRAY 80', SURF_ID='Promatect'/ floor
&OBST XB=0.0,0.02,0.02,1.18,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-back
&OBST XB=1.7,1.8,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-1
&OBST XB=1.7,1.8,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-2
&OBST XB=-0.1,0.0,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-3
&OBST XB=-0.1,0.0,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-4
&OBST XB=0.0,1.7,1.2,1.3,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-2
&OBST XB=0.0,1.7,-0.1,0.0,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-1
&OBST XB=-0.1,0.0,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-4
&OBST XB=1.7,1.8,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-3
&OBST XB=5.65,5.75,-0.6,-0.5,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-1
&OBST XB=5.65,5.75,1.8,1.9,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-2
&OBST XB=0.0,0.1,1.8,1.9,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-3
&OBST XB=0.0,0.1,-0.6,-0.5,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-4
&OBST XB=1.82,3.02,0.0,0.01,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side1
&OBST XB=3.01,3.02,0.0,1.2,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-front
&OBST XB=2.27,2.57,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side-
&OBST XB=2.27,2.57,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side
&OBST XB=1.82,3.02,1.2,1.21,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side2
&OBST XB=1.82,1.83,0.0,1.2,1.3,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-back
&OBST XB=2.57,2.57,0.45,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-front
&OBST XB=2.27,2.57,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-up
&OBST XB=-0.5,2.27,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-up
&OBST XB=-0.5,2.27,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side
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&OBST XB=-0.5,2.27,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side-left

&OBST XB=-0.5,2.27,0.45,0.75,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-bottom

&OBST XB=0.8,1.0,0.5,0.7,0.02,0.22, COLOR='RED', SURF_IDS='Burner','Steel_sheet','Steel_sheet'/ burner-pan

&OBST XB=4.73,5.48,0.12,1.05,1.86,1.86, SURF_ID='entrance'/ air-entrance

&OBST XB=4.73,4.73,0.12,1.08,1.86,3.06, COLOR='BLACK', SURF_ID='Steel_sheet'/ plate-1

&OBST XB=5.48,5.48,0.12,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-2

&OBST XB=4.73,5.48,1.08,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-3

&OBST XB=4.73,5.48,0.12,0.12,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-4

&OBST XB=1.8,1.84167,-0.0166667,1.19167,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.925,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.96667,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.05,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.09167,0.233333,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.175,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.21667,0.358333,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.25833,0.4,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-
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&OBST XB=1.84167,1.84167,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,1.96667,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.05,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.09167,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.175,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.21667,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,-0.0166667,0.025,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.88333,2.96667,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.0666667,0.108333,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.108333,0.15,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.00833,2.84167,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.05,2.8,0.191667,0.233333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.09167,2.75833,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.13333,2.71667,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.63333,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.25833,2.59167,0.4,0.441667,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.84167,3.00833,0.025,0.025,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.108333,0.108333,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.15,0.15,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.05,2.8,0.233333,0.233333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.09167,2.71667,0.275,0.275,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.358333,0.358333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.59167,0.4,0.4,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.84167,3.00833,1.15,1.19167,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.88333,2.96667,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.06667,1.10833,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.00833,2.84167,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.75833,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.13333,2.71667,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.175,2.675,0.816667,0.858333,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.63333,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.25833,2.59167,0.733333,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.84167,3.00833,1.19167,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.10833,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.983333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.71667,0.9,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.175,2.675,0.858333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.59167,0.775,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.55,2.59167,0.441667,0.733333,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.59167,2.675,0.4,0.775,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.63333,2.675,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.63333,2.675,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.675,2.71667,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.75833,2.8,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.75833,2.8,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.8,2.88333,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.88333,2.925,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,3.00833,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00833,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00833,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.59167,2.59167,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

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&OBST XB=2.675,2.675,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.71667,2.71667,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.8,2.8,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.88333,2.88333,0.15,1.025,1.68125,1.725, COLOR='GRAY60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,2.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=3.00833,3.00833,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='Steel_sheet'/ Slab-front

&VENT SURF_ID='OPEN', XB=4.7,5.48,0.12,1.08,3.06,3.06/ Vent-5

&VENT SURF_ID='OPEN', XB=1.8,3.02,0.0,1.2,1.2,1.2/ Vent-hood-2

&VENT SURF_ID='Outlet', XB=-0.4,-0.4,0.45,0.75,1.9,2.2/ vent-exit

&VENT SURF_ID='OPEN', XB=2.27,2.57,0.45,0.75,1.9,1.9/ Vent-hood-3-up

&BNDF QUANTITY='INCIDENT HEAT FLUX'/ &BNDF QUANTITY='NORMAL VELOCITY'/

&BNDF QUANTITY='PRESSURE COEFFICIENT'/ &BNDF QUANTITY='RADIATIVE HEAT FLUX'/

&BNDF QUANTITY='RADIOMETER'/ &SLCF QUANTITY='THERMOCOUPLE', PBX=0.04/

&SLCF QUANTITY='HRRPUV', PBX=0.63/ &SLCF QUANTITY='PRESSURE', PBX=0.63/

&SLCF QUANTITY='TEMPERATURE', PBX=0.63/ &SLCF QUANTITY='U-VELOCITY', PBX=0.63/

&SLCF QUANTITY='VELOCITY', PBX=0.63/ &SLCF QUANTITY='THERMOCOUPLE', PBX=1.84/

&SLCF QUANTITY='PRESSURE', PBX=2.4/ &SLCF QUANTITY='TEMPERATURE', PBX=2.4/

&SLCF QUANTITY='U-VELOCITY', PBX=2.4/ &SLCF QUANTITY='VELOCITY', PBX=2.4/

&SLCF QUANTITY='PRESSURE', PBX=5.1/ &SLCF QUANTITY='TEMPERATURE', PBX=5.1/

&SLCF QUANTITY='U-VELOCITY', PBX=5.1/ &SLCF QUANTITY='VELOCITY', PBX=5.1/

&SLCF QUANTITY='HRRPUV', PBY=0.3/ &SLCF QUANTITY='PRESSURE', PBY=0.4/

&SLCF QUANTITY='PRESSURE ZONE', PBY=0.4/ &SLCF QUANTITY='TEMPERATURE', PBY=0.4/

&SLCF QUANTITY='V-VELOCITY', PBY=0.4/ &SLCF QUANTITY='VELOCITY', PBY=0.4/

&SLCF QUANTITY='TEMPERATURE', PBY=0.5/ &SLCF QUANTITY='V-VELOCITY', PBY=0.5/

&SLCF QUANTITY='VELOCITY', PBY=0.5/  &SLCF QUANTITY='PRESSURE', PBY=0.6/

&SLCF QUANTITY='TEMPERATURE', PBY=0.6/  &SLCF QUANTITY='THERMOCOUPLE', PBY=0.6/
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&SLCF QUANTITY='V-VELOCITY', PBY=0.6/  &SLCF QUANTITY='VELOCITY', PBY=0.6/

&SLCF QUANTITY='PRESSURE', PBY=0.8/  &SLCF QUANTITY='TEMPERATURE', PBY=0.8/

&SLCF QUANTITY='PRESSURE', PBY=1.0/  &SLCF QUANTITY='TEMPERATURE', PBY=1.0/

&SLCF QUANTITY='V-VELOCITY', PBY=1.0/  &SLCF QUANTITY='VELOCITY', PBY=1.0/

&SLCF QUANTITY='THERMOCOUPLE', PBY=1.16/  &SLCF QUANTITY='V-VELOCITY', PBY=1.2/

&SLCF QUANTITY='VELOCITY', PBY=1.2/  &SLCF QUANTITY='PRESSURE', PBZ=0.6/

&SLCF QUANTITY='TEMPERATURE', PBZ=0.6/ &SLCF QUANTITY='W-VELOCITY', PBZ=0.6/

&TAIL /
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9.2.5 FDS code for the fifth model in experiment 1:

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&HEAD CHID='5-platform-S-Heptane'/

&TIME T_END=900.0/

&DUMP RENDER_FILE='5-platform-S-Heptane.ge1',  DT_RESTART=300.0/

&MISC GROUND_LEVEL=-0.75, TMPA=16.0/

&MESH ID='0-0-room', FYI='Mesh-room', IJK=6,30,9, XB=-0.5,0.0,-0.6,1.9,-0.75,0.0/

&MESH ID='0-1-room', FYI='Mesh-room', IJK=6,30,12, XB=-0.5,0.0,-0.6,1.9,0.0,1.2/

&MESH ID='0-2-room', FYI='Mesh-room', IJK=6,30,8, XB=-0.5,0.0,-0.6,1.9,1.2,1.9/

&MESH ID='0-3-room-duct', FYI='Mesh-room', IJK=12,60,8, XB=-0.5,0.0,-0.6,1.9,1.9,2.2/

&MESH ID='1-1-room', FYI='Mesh-room', IJK=12,30,9, XB=0.0,1.1,-0.6,1.9,-0.75,0.0/

&MESH ID='1-2-room', FYI='Mesh-room', IJK=24,60,24, XB=0.0,1.1,-0.6,1.9,0.0,1.2/

&MESH ID='1-3-room', FYI='Mesh-room', IJK=12,30,8, XB=0.0,1.1,-0.6,1.9,1.2,1.9/

&MESH ID='1-4-room-duct', FYI='Mesh-room', IJK=24,60,8, XB=0.0,1.1,-0.6,1.9,1.9,2.2/

&MESH ID='2-0-room', FYI='Mesh-room', IJK=8,30,9, XB=1.1,1.8,-0.6,1.9,-0.75,0.0/

&MESH ID='2-1-room', FYI='Mesh-room', IJK=16,60,24, XB=1.1,1.8,-0.6,1.9,0.0,1.2/

&MESH ID='2-2-room', FYI='Mesh-room', IJK=8,30,8, XB=1.1,1.8,-0.6,1.9,1.2,1.9/

&MESH ID='2-3-room-duct', FYI='Mesh-room', IJK=16,60,8, XB=1.1,1.8,-0.6,1.9,1.9,2.2/

&MESH ID='3-0-hood', FYI='Mesh-hood', IJK=24,30,9, XB=1.8,3.8,-0.6,1.9,-0.75,0.0/

&MESH ID='3-1-hood', FYI='Mesh-hood', IJK=48,60,24, XB=1.8,3.8,-0.6,1.9,0.0,1.2/

&MESH ID='3-2-hood', FYI='Mesh-hood', IJK=48,60,16, XB=1.8,3.8,-0.6,1.9,1.2,1.9/

&MESH ID='3-3-hood', FYI='Mesh-hood', IJK=48,60,8, XB=1.8,3.8,-0.6,1.9,1.9,2.2/
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&MESH ID='4-0-air', IJK=22,30,9, XB=3.8,5.8,-0.6,1.9,-0.75,0.0/

&MESH ID='4-1-air', IJK=44,60,24, XB=3.8,5.8,-0.6,1.9,0.0,1.2/

&MESH ID='4-2-air', IJK=44,60,16, XB=3.8,5.8,-0.6,1.9,1.2,1.9/

&MESH ID='4-3-air', IJK=44,60,8, XB=3.8,5.8,-0.6,1.9,1.9,2.2/

&MESH ID='4-4-air', IJK=44,60,20, XB=3.8,5.8,-0.6,1.9,2.2,3.0/

&DEVC ID='FLOW-0ut of door', QUANTITY='MASS FLOW', XB=2.4,2.4,0.0,1.2,0.1,1.18/

&DEVC ID='FLOW-duct', QUANTITY='MASS FLOW',  XB=0.63,0.63,0.45,0.75,1.9,2.2/

&DEVC ID='GAS-P', QUANTITY='PRESSURE', XYZ=0.63,0.6,2.05/&DEVC ID='GAS-T', QUANTITY='TEMPERATURE',
XYZ=0.63,0.6,2.05/ &DEVC ID='GAS-V', QUANTITY='VELOCITY', XYZ=0.63,0.6,2.05/

&DEVC ID='THCP-inside corner-1', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.15/

&DEVC ID='THCP-inside corner-10', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.6/

&DEVC ID='THCP-inside corner-11', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.65/

&DEVC ID='THCP-inside corner-12', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.7/

&DEVC ID='THCP-inside corner-13', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.75/

&DEVC ID='THCP-inside corner-14', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.8/

&DEVC ID='THCP-inside corner-15', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.85/

&DEVC ID='THCP-inside corner-16', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.9/

&DEVC ID='THCP-inside corner-17', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.95/

&DEVC ID='THCP-inside corner-18', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.0/

&DEVC ID='THCP-inside corner-19', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,1.05/

&DEVC ID='THCP-inside corner-2', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.2/

&DEVC ID='THCP-inside corner-3', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.25/

&DEVC ID='THCP-inside corner-4', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.3/

&DEVC ID='THCP-inside corner-5', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.35/

&DEVC ID='THCP-inside corner-6', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.4/

&DEVC ID='THCP-inside corner-7', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.45/

&DEVC ID='THCP-inside corner-8', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.5/

&DEVC ID='THCP-inside corner-9', QUANTITY='THERMOCOUPLE', XYZ=0.04,1.16,0.55/

&DEVC ID='THCP-middle of door-1', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.26/

&DEVC ID='THCP-middle of door-10', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.14/
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&DEVC ID='THCP-middle of door-2', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.36/

&DEVC ID='THCP-middle of door-3', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.46/

&DEVC ID='THCP-middle of door-4', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.56/

&DEVC ID='THCP-middle of door-5', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.66/

&DEVC ID='THCP-middle of door-6', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.76/

&DEVC ID='THCP-middle of door-7', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.86/

&DEVC ID='THCP-middle of door-8', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,0.96/

&DEVC ID='THCP-middle of door-9', QUANTITY='THERMOCOUPLE', XYZ=1.84,0.6,1.06/

&MATL ID='PROMATECT_H',      SPECIFIC_HEAT=0.92,
CONDUCTIVITY_RAMP='PROMATECT_H_CONDUCTIVITY_RAMP',      DENSITY=870.0/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=20.0, F=0.17/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=100.0, F=0.19/

&RAMP ID='PROMATECT_H_CONDUCTIVITY_RAMP', T=200.0, F=0.21/

&MATL ID='STEEL',      FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',

     SPECIFIC_HEAT=0.46,      CONDUCTIVITY=45.8,      DENSITY=7850.0,      EMISSIVITY=0.95/

&SURF ID='Promatect',      COLOR='WHITE',      MATL_ID(1,1)='PROMATECT_H',

  MATL_MASS_FRACTION(1,1)=1.0,      THICKNESS(1)=0.012/

&SURF ID='Steel_sheet',      COLOR='GRAY 60',      MATL_ID(1,1)='STEEL',      MATL_MASS_FRACTION(1,1)=1.0,

     THICKNESS(1)=0.002/&SURF ID='Burner',      FYI='HEPTANE',      COLOR='RED',

     TEXTURE_MAP='psm_fire.jpg',      HRRPUA=841.29,      RAMP_Q='Burner_RAMP_Q',

     PART_ID='Fuel',      DT_INSERT=1.0/  &RAMP ID='Burner_RAMP_Q', T=0.0, F=0.0/

&RAMP ID='Burner_RAMP_Q', T=30.0, F=0.0/  &RAMP ID='Burner_RAMP_Q', T=31.0, F=1.0/

&SURF ID='entrance',      RGB=51,255,51,      VOLUME_FLUX=-1.209/ &SURF ID='Outlet',

     COLOR='BLUE',      VOLUME_FLUX=0.5969/

&OBST XB=0.0,1.8,0.0,1.2,1.22,1.24, RGB=255,255,153, SURF_ID='Promatect'/ ceilling

&OBST XB=1.8,1.82,0.85,1.45,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-left

&OBST XB=1.8,1.82,-0.25,0.35,0.02,1.1, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-right

&OBST XB=1.8,1.82,-0.3,1.5,1.1,1.4, RGB=255,255,153, SURF_ID='Promatect'/ wall-door-up

&OBST XB=0.0,1.8,0.0,0.02,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-right

&OBST XB=0.0,1.8,1.18,1.2,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-side-left
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&OBST XB=-0.15,1.9,-0.6,1.9,0.0,0.02, COLOR='GRAY 80', SURF_ID='Promatect'/ floor

&OBST XB=0.0,0.02,0.02,1.18,0.02,1.22, RGB=255,255,153, SURF_ID='Promatect'/ wall-back

&OBST XB=1.7,1.8,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-1

&OBST XB=1.7,1.8,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-2

&OBST XB=-0.1,0.0,-0.1,0.0,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-3

&OBST XB=-0.1,0.0,1.2,1.3,0.02,2.4, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-4

&OBST XB=0.0,1.7,1.2,1.3,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-2

&OBST XB=0.0,1.7,-0.1,0.0,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-1

&OBST XB=-0.1,0.0,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-4

&OBST XB=1.7,1.8,0.0,1.2,1.24,1.34, COLOR='GRAY 80', SURF_ID='INERT'/ column-H-3

&OBST XB=1.8,1.85,-0.6,-0.5,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-1

&OBST XB=1.8,1.85,1.8,1.9,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-2

&OBST XB=0.0,0.1,1.8,1.9,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-3

&OBST XB=0.0,0.1,-0.6,-0.5,-0.75,0.0, COLOR='GRAY 80', SURF_ID='INERT'/ column-v-b-4

&OBST XB=1.82,3.02,0.0,0.01,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side1

&OBST XB=3.01,3.02,0.0,1.2,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-front

&OBST XB=2.27,2.57,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side-

&OBST XB=2.27,2.57,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-side

&OBST XB=1.82,3.02,1.2,1.21,1.2,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side2

&OBST XB=1.82,1.83,0.0,1.2,1.3,1.6, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-back

&OBST XB=2.57,2.57,0.45,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-front

&OBST XB=2.27,2.57,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-up-up

&OBST XB=-0.5,2.27,0.45,0.75,2.2,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-up

&OBST XB=-0.5,2.27,0.45,0.45,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side

&OBST XB=-0.5,2.27,0.75,0.75,1.9,2.2, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-side-left

&OBST XB=-0.5,2.27,0.45,0.75,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ duct-bottom

&OBST XB=0.8,1.0,0.5,0.7,0.02,0.22, COLOR='RED', SURF_IDS='Burner','Steel_sheet','Steel_sheet'/ burner-pan

&OBST XB=4.73,5.48,0.12,1.05,1.86,1.86, SURF_ID='entrance'/ air-entrance

&OBST XB=4.73,4.73,0.12,1.08,1.86,3.06, COLOR='BLACK', SURF_ID='Steel_sheet'/ plate-1
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&OBST XB=5.48,5.48,0.12,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-2

&OBST XB=4.73,5.48,1.08,1.08,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-3

&OBST XB=4.73,5.48,0.12,0.12,1.86,3.06, COLOR='BLACK', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ plate-side-4

&OBST XB=1.8,1.84167,-0.0166667,1.19167,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.88333,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.84167,1.925,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.96667,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.00833,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,2.05,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.09167,0.233333,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.13333,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.175,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.21667,0.358333,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.25833,0.4,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.84167,1.84167,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.925,1.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=1.96667,1.96667,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.05,2.05,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.09167,2.09167,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.175,2.175,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-back

&OBST XB=2.21667,2.21667,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,-0.0166667,0.025,1.59375,1.59375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.88333,2.96667,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.0666667,0.108333,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.108333,0.15,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.00833,2.84167,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.05,2.8,0.191667,0.233333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.09167,2.75833,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.13333,2.71667,0.275,0.316667,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.316667,0.358333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.63333,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.25833,2.59167,0.4,0.441667,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,0.025,0.025,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.925,2.925,0.108333,0.108333,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=1.96667,2.88333,0.15,0.15,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.05,2.8,0.233333,0.233333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.09167,2.71667,0.275,0.275,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.175,2.675,0.358333,0.358333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-1

&OBST XB=2.21667,2.59167,0.4,0.4,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-

&OBST XB=1.84167,3.00833,1.15,1.19167,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.88333,2.96667,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.06667,1.10833,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.00833,2.84167,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.941667,0.983333,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.75833,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.13333,2.71667,0.858333,0.9,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.175,2.675,0.816667,0.858333,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.63333,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.25833,2.59167,0.733333,0.775,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=1.84167,3.00833,1.19167,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.925,2.925,1.10833,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=1.96667,2.88333,1.025,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.05,2.8,0.983333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.09167,2.71667,0.9,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.175,2.675,0.858333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-side-2

&OBST XB=2.21667,2.59167,0.775,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.55,2.59167,0.441667,0.733333,1.9,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.59167,2.675,0.4,0.775,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.63333,2.675,0.358333,0.4,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.63333,2.675,0.775,0.816667,1.85625,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.675,2.71667,0.316667,0.858333,1.8125,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.71667,2.8,0.275,0.9,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.75833,2.8,0.233333,0.275,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.75833,2.8,0.9,0.941667,1.76875,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.8,2.88333,0.191667,0.983333,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.15,0.191667,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.84167,2.88333,0.983333,1.025,1.725,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.88333,2.925,0.108333,1.06667,1.68125,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,3.00833,0.0666667,1.10833,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00833,0.025,0.0666667,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.96667,3.00833,1.10833,1.15,1.6375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.59167,2.59167,0.4,0.775,1.85625,1.9, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.675,2.675,0.358333,0.858333,1.8125,1.85625, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.71667,2.71667,0.275,0.9,1.76875,1.8125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.8,2.8,0.233333,0.983333,1.725,1.76875, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/

&OBST XB=2.88333,2.88333,0.15,1.025,1.68125,1.725, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=2.925,2.925,0.108333,1.10833,1.6375,1.68125, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&OBST XB=3.00833,3.00833,0.025,1.19167,1.59375,1.6375, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='Steel_sheet'/ Slab-front

&VENT SURF_ID='OPEN', XB=4.7,5.48,0.12,1.08,3.06,3.06/ Vent-5

&VENT SURF_ID='OPEN', XB=1.8,3.02,0.0,1.2,1.2,1.2/ Vent-hood-2

&VENT SURF_ID='Outlet', XB=-0.5,-0.5,0.45,0.75,1.9,2.2/ vent-exit

&VENT SURF_ID='OPEN', XB=2.27,2.57,0.45,0.75,1.9,1.9/ Vent-hood-3-up

&BNDF QUANTITY='INCIDENT HEAT FLUX'/ &BNDF QUANTITY='NORMAL VELOCITY'/

&BNDF QUANTITY='PRESSURE COEFFICIENT'/ &BNDF QUANTITY='RADIATIVE HEAT FLUX'/

&BNDF QUANTITY='RADIOMETER'/ &SLCF QUANTITY='THERMOCOUPLE', PBX=0.04/

&SLCF QUANTITY='HRRPUV', PBX=0.63/ &SLCF QUANTITY='PRESSURE', PBX=0.63/

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&SLCF QUANTITY='VELOCITY', PBX=0.63/ &SLCF QUANTITY='THERMOCOUPLE', PBX=1.84/

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&SLCF QUANTITY='PRESSURE', PBX=5.1/ &SLCF QUANTITY='TEMPERATURE', PBX=5.1/

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&SLCF QUANTITY='HRRPUV', PBY=0.3/ &SLCF QUANTITY='PRESSURE', PBY=0.4/

&SLCF QUANTITY='PRESSURE ZONE', PBY=0.4/ &SLCF QUANTITY='TEMPERATURE', PBY=0.4/

&SLCF QUANTITY='V-VELOCITY', PBY=0.4/ &SLCF QUANTITY='VELOCITY', PBY=0.4/

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&SLCF QUANTITY='VELOCITY', PBY=0.5/ &SLCF QUANTITY='PRESSURE', PBY=0.6/

&SLCF QUANTITY='TEMPERATURE', PBY=0.6/ &SLCF QUANTITY='THERMOCOUPLE', PBY=0.6/

&SLCF QUANTITY='V-VELOCITY', PBY=0.6/ &SLCF QUANTITY='VELOCITY', PBY=0.6/

&SLCF QUANTITY='PRESSURE', PBY=0.8/ &SLCF QUANTITY='TEMPERATURE', PBY=0.8/

&SLCF QUANTITY='PRESSURE', PBY=1.0/ & SLCF QUANTITY='TEMPERATURE', PBY=1.0/

&SLCF QUANTITY='V-VELOCITY', PBY=1.0/ & SLCF QUANTITY='VELOCITY', PBY=1.0/

&SLCF QUANTITY='THERMOCOUPLE', PBY=1.16/ & SLCF QUANTITY='V-VELOCITY', PBY=1.2/

&SLCF QUANTITY='VELOCITY', PBY=1.2/ & SLCF QUANTITY='PRESSURE', PBZ=0.6/

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&SLCF QUANTITY='TEMPERATURE', PBZ=0.6/  & SLCF QUANTITY='W-VELOCITY', PBZ=0.6/

&TAIL /
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