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Knowledge FOR Resilient soCiEty

2ND INTERNATIONAL SYMPOSIUM K-FORCE 2019

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APPROACHES OF ENCLOSURE FIRE DEFINITION IN PROGRAMS FDS AND CFAST

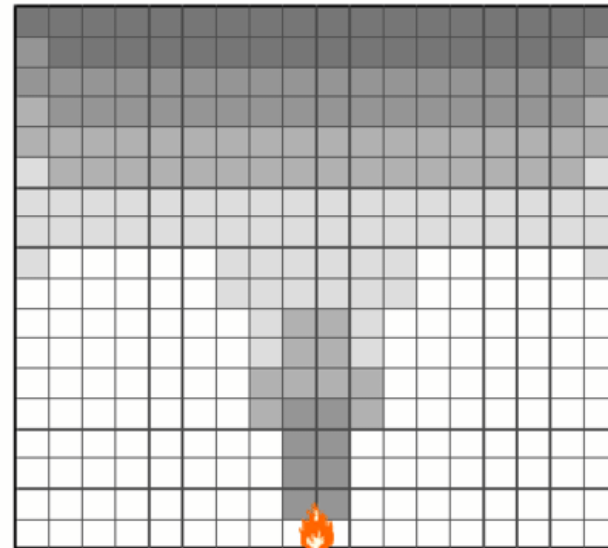
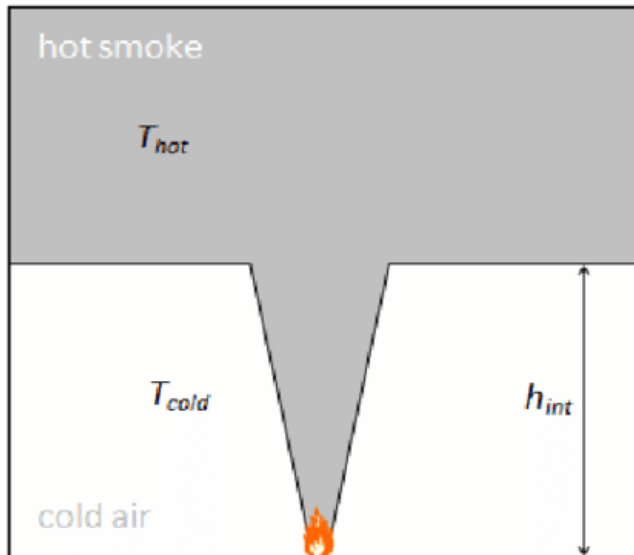
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INTRODUCTION

Enclosure fire modelling using both

zone (CFAST) and CFD (FDS) model.



APPROACHES OF FIRE DEFINITION

*Different **detail levels** of enclosure fire modelling*



two extremes: 1. fully furnished room,

2. empty room with prescribed

fire.

*Reduction in fire specification brings **uncertainty** into the process of fire modelling.*



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APPROACHES OF FIRE DEFINITION

Case study: fire modelling of a sofa in enclosure space.

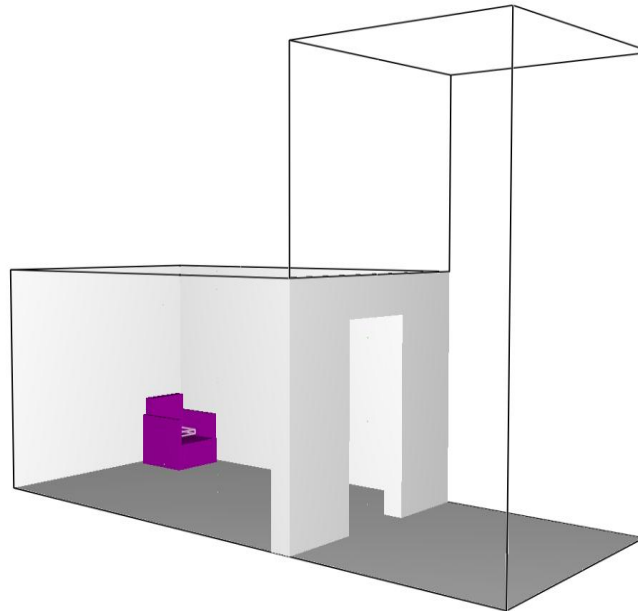
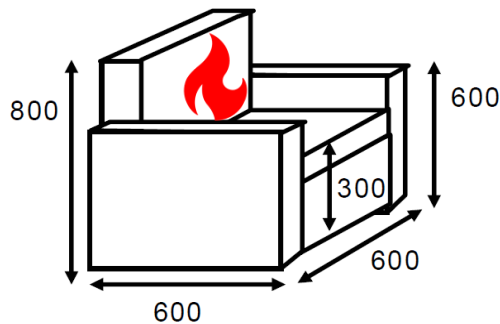
Different fire definition approaches in softwares FDS and CFAST.

Fire definition	Fire model	Aplication approach
Furniture fire in rectangular geometry	FDS	Enclosure space / free combustion
Fire with prescribed HRR per area	FDS, CFAST	Enclosure space (HRR values from ISO 9705) Enclosure space (HRR values from furniture calorimeter) Enclosure space (engineering approach – t^x fire)
Radially spreading fire	FDS, CFAST	Enclosure space / free combustion

CREATED SCENARIOS

Space dimensions: 2.4 x 3.6 x 2.4 m with an opening of 0.8 x 2.0 m (corresponding with the "room corner test" according to ISO 9705)

1. Fire of furniture in r



CREATED SCENARIOS

2. Fire with prescribed HRR per area

$$HRRPUA = \frac{HRR}{S}$$

where:

HRRPUA – heat release rate per unit area [kW/m²],

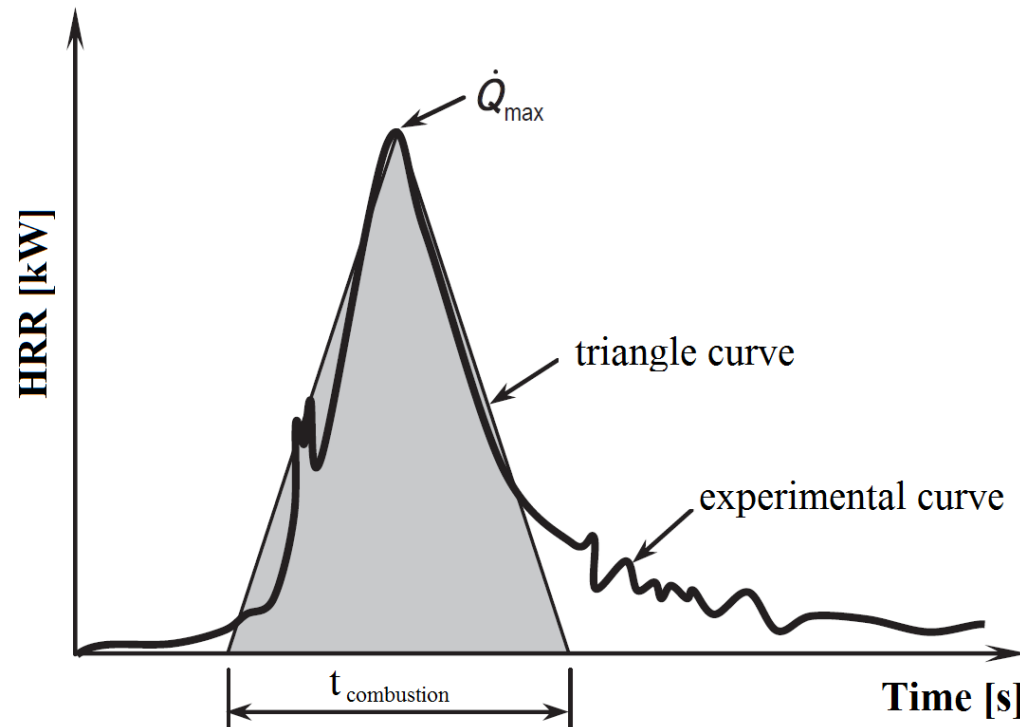
HRR – heat release rate [kW],

S – fuel burning area [m²].



CREATED SCENARIOS

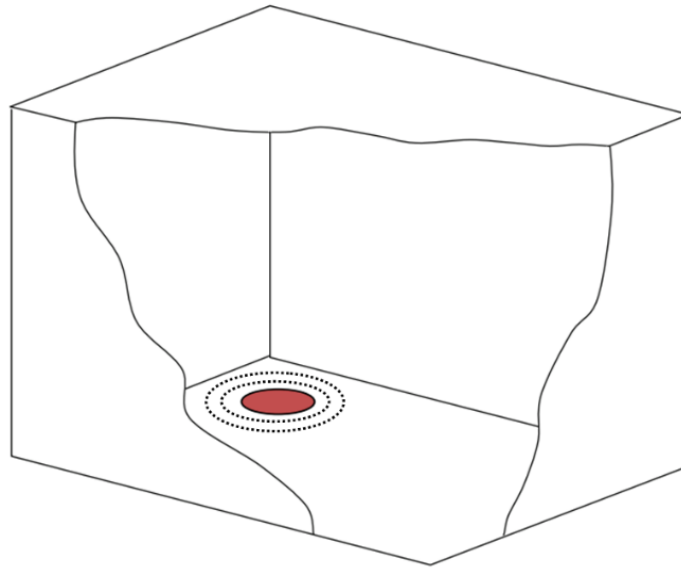
3. t^x fire with prescribed HRR per area



Triangular fire model of upholstered furniture

CREATED SCENARIOS

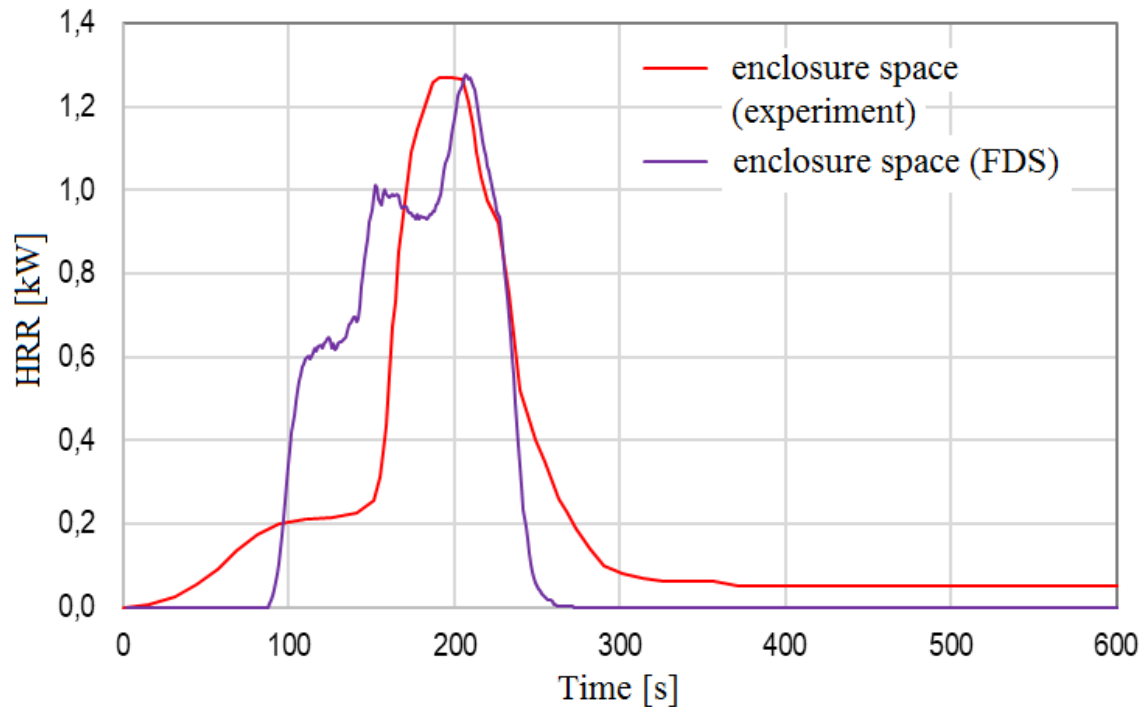
4. *Radially spreading fire*



Radially spreading fire in the enclosed space

OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

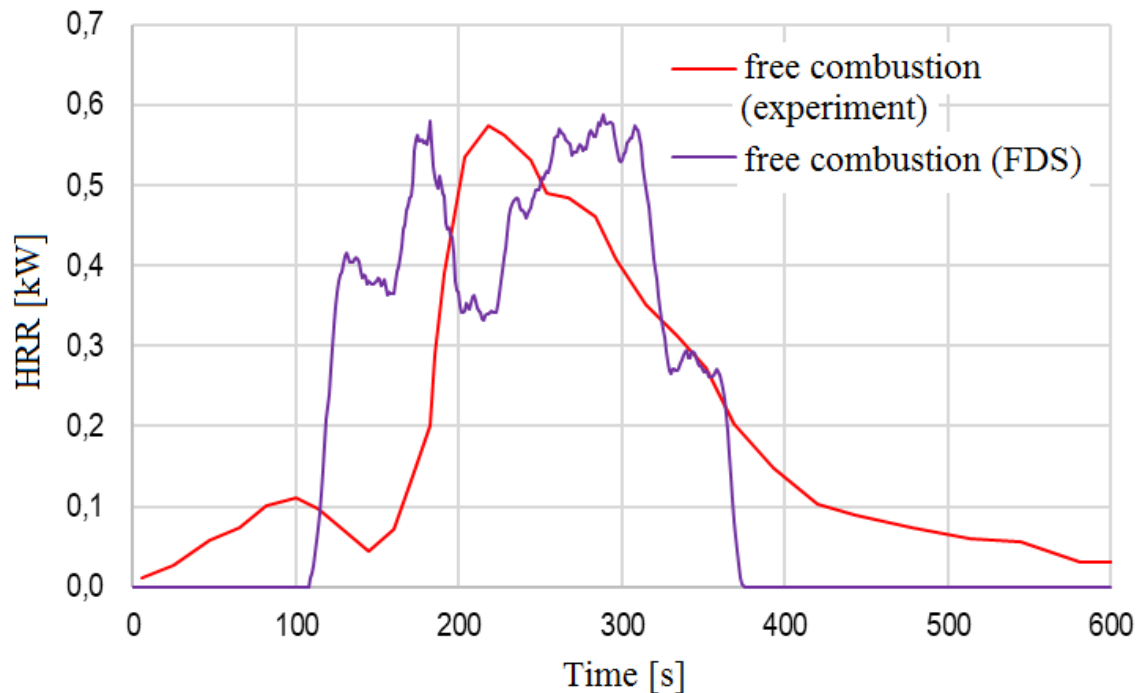
1. Fire of furniture in real geometry



Comparison of experimental and modeled outputs in the enclosed room according to ISO 9705

OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

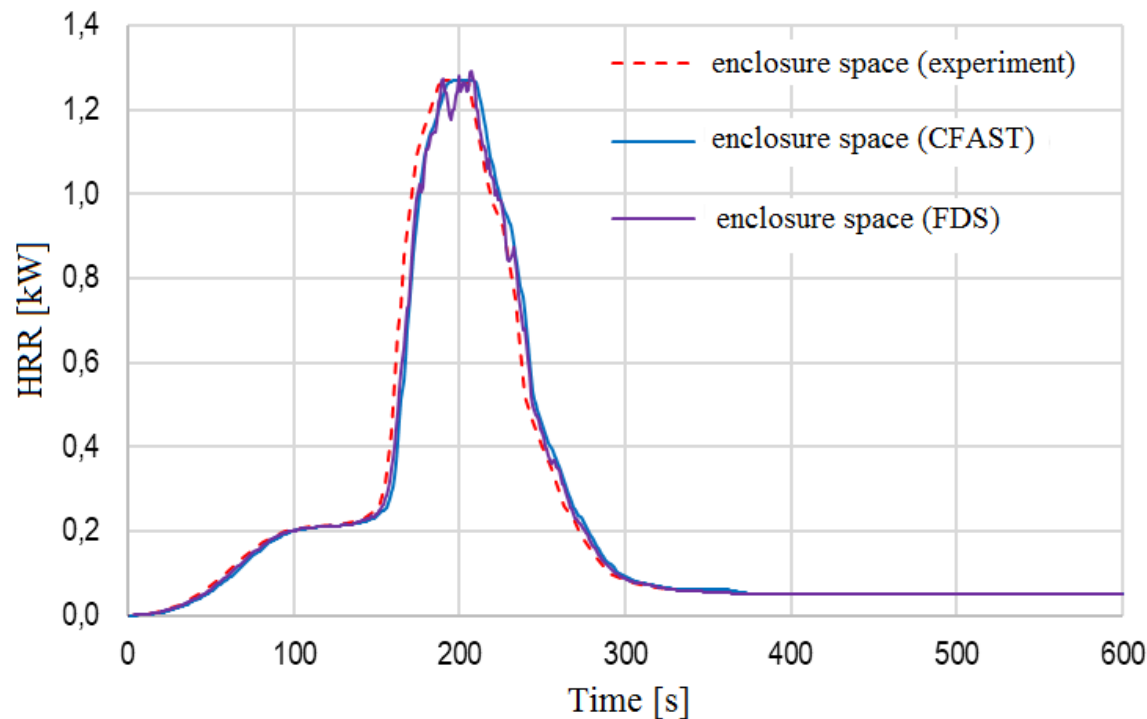
1. Fire of furniture in real geometry



Differences between experimental measurements and FDS modelling by free combustion

OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

2. Fire with prescribed HRR per area



*Differences in fire performance between fire of furniture
in rectangular geometry and fire with prescribed HRR per
area*

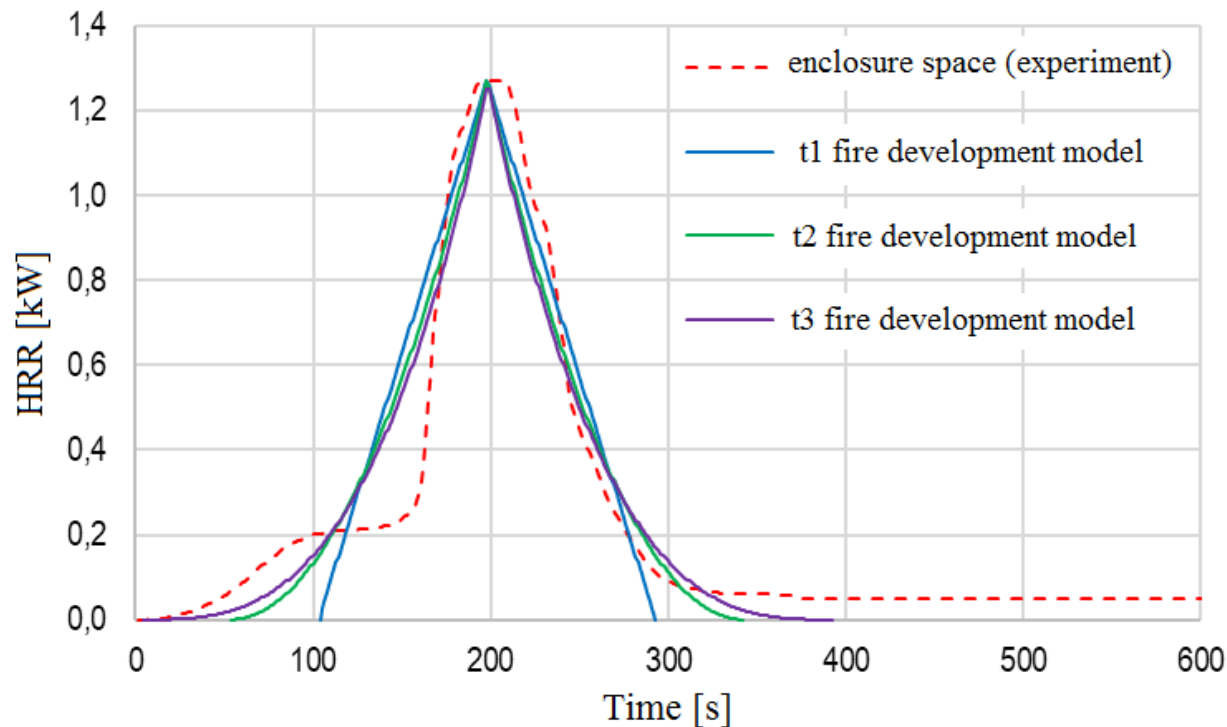


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OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

3. t^x fire with prescribed HRR per area



Simplified t^x sofa fire model

OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

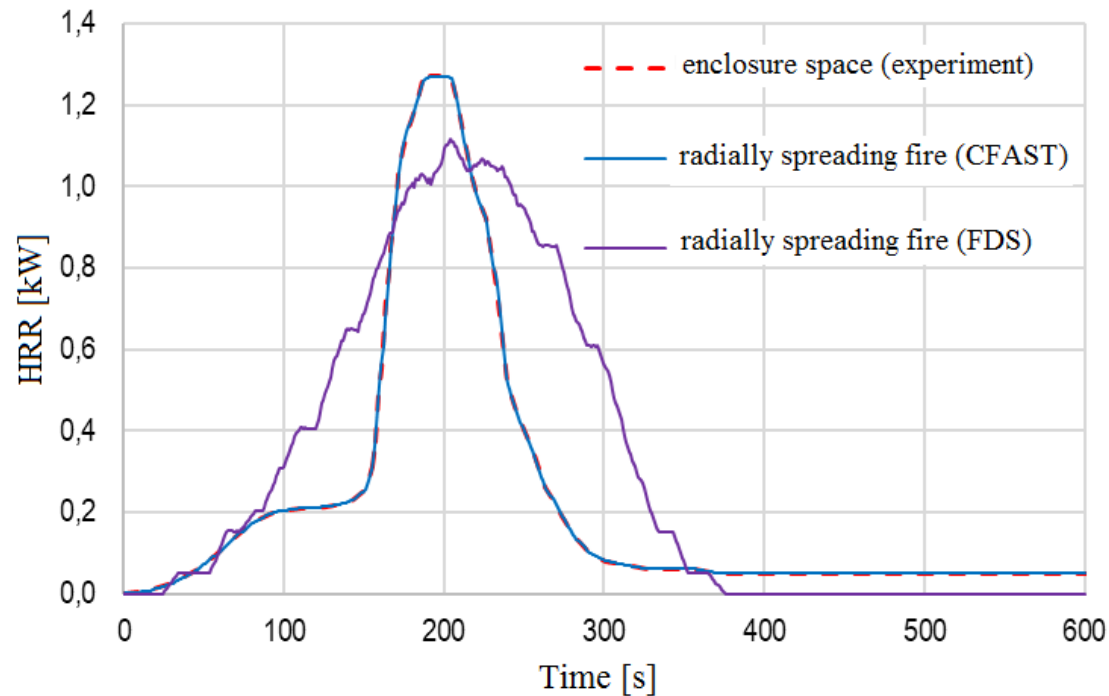
3. t^x fire with prescribed HRR per area

Differences in total released heat between experiment and selected fire models

Fire model	Coefficient α [kW s^{-2}]	Total released heat [MW]	Difference comparing to experiment [MW]
t^1 fire model	13,3684	120,6	-9,0
t^2 fire model	0,0604	121,5	-0,3
t^3 fire model	0,0002	122,6	2,9

OUTPUTS OF INDIVIDUAL FIRE DEFINITION APPROACHES

4. Radially spreading fire



*Radially spreading fire of upholstered sofa
in FDS and CFAST*

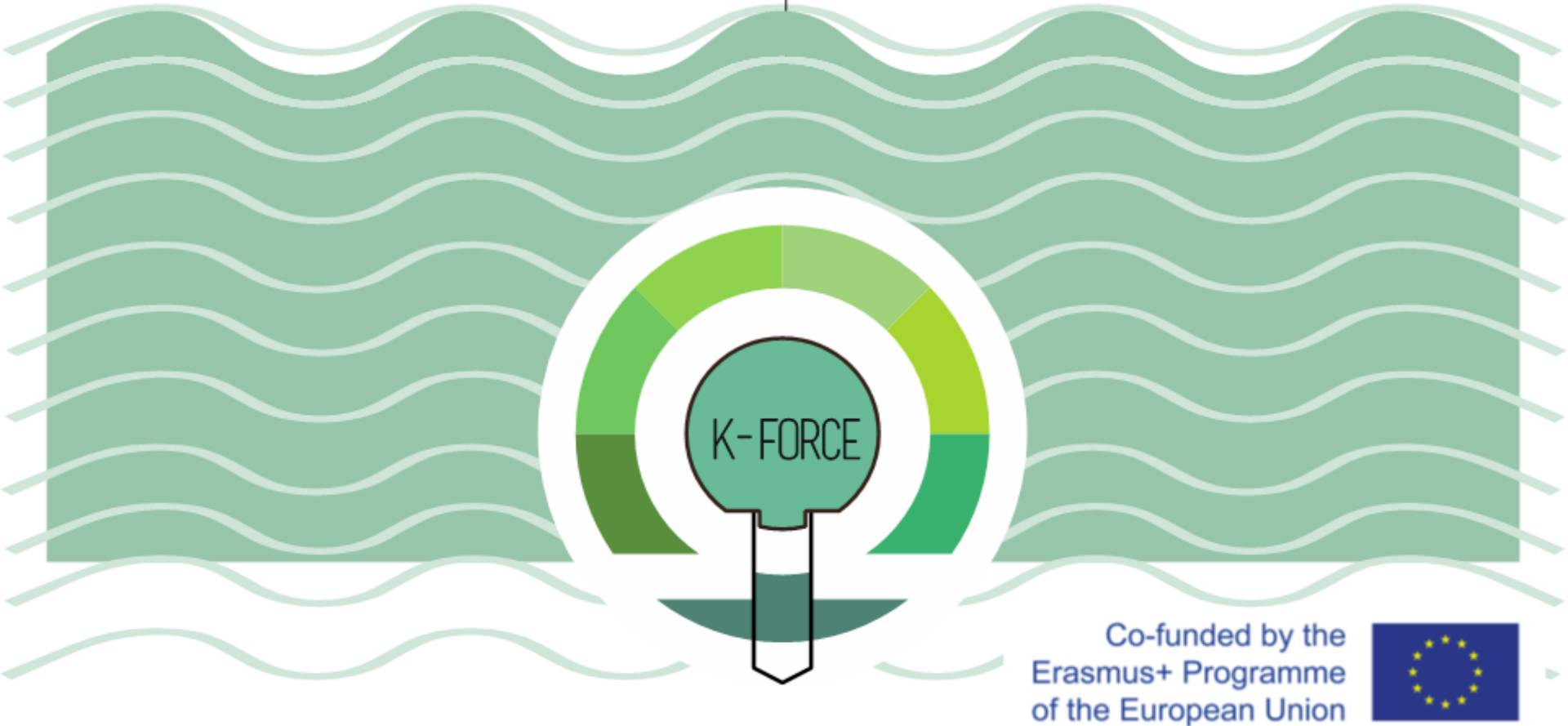
COCLUSIONS

*The definition of fire is largely influenced not only by the variability of the **different ways** in which a fire can be **prescribed**, but also by the **uncertainty** associated with the **input data** itself.*

*The carried out case study showed the **importance of defining fire** in the modelling process.*

High sensitivity to the available input data and the fact that it is not possible to isolate the individual fuel parameters and the development of combustion, which would generate randomly generated data, were confirmed.





Thank you
for your attention
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