



2ND INTERNATIONAL SYMPOSIUM K-FORCE 2019

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IT TEACHING TOOLS FOR BUILDING FIRE SAFETY

INTRODUCTION

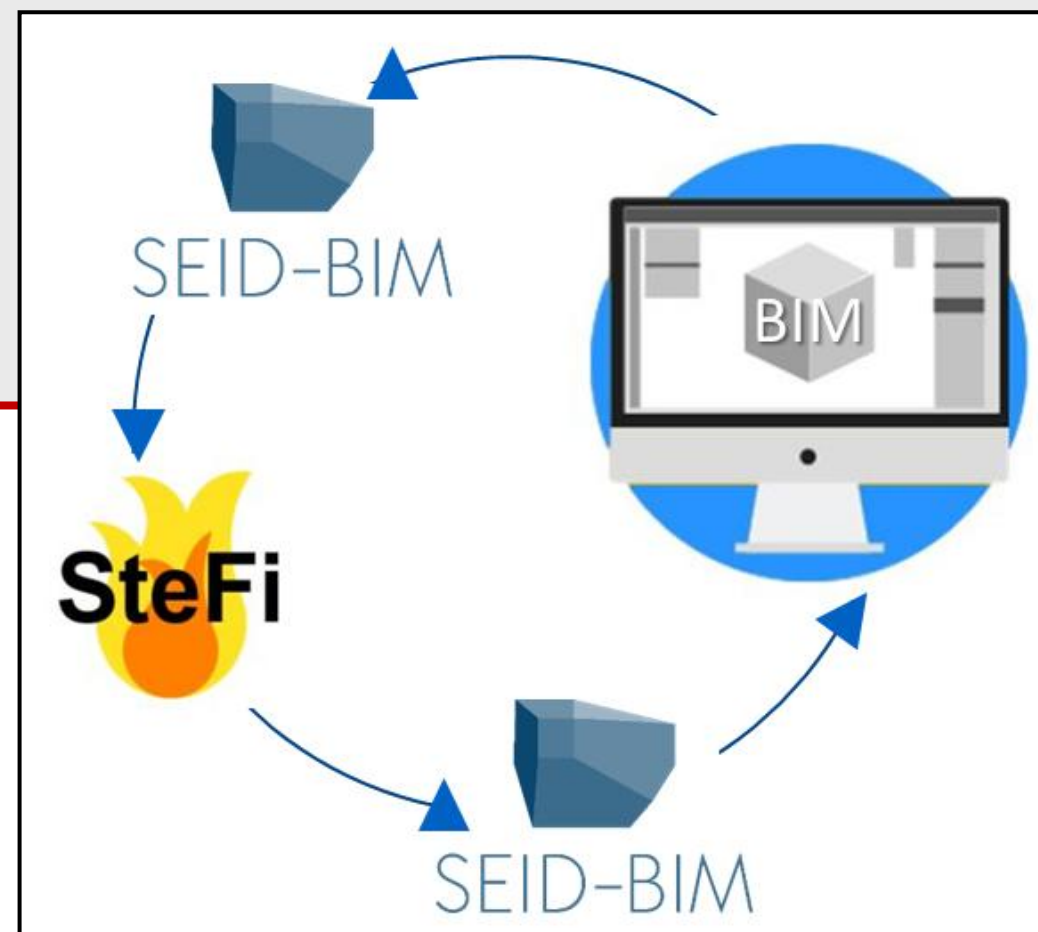
Two integrated software have been developed at DTU to address two current issues of fire safety design of structures: the lack of a fast tool for parametric fire design of structural elements (software called **SteFi**) and the difficulties of importing and exporting the structural data from and into a BIM-environment (software called **SEID-BIM**).

The software is *open source* and mainly developed as aid for teaching and learning. Since the commercial use is not restricted, it can also be used or further developed by the industry.

CORE IDEA OF THE RESEARCH

SteFi Steel in Fire

- Standard and Parametric design fires
- Reliable steel degradation models
- Libraries for steel profiles and insulation materials
- Calculation of load capacity
- Design of required insulation



Structural Export and Import of Data for BIM



- Export geometry and material properties of a steel element from Revit
- Import geometry and material properties of the insulation into Revit
- Compatible with the IFC format

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

Section Type: I-Profile

Height (H): 400 mm Yield strength at 20°C (fyk): 240 MPa

Width (B): 180 mm Stiffness at 20°C (Es): 210 GPa

Web thickness (tw): 8.6 mm Steel density (ps): 7850 kg/m³

Flange thickness (tf): 13.5 mm Partial factor γ_{M,fi}: 1.0

Rounding (r): 21 mm

DATA OF THE CROSS-SECTION

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

Element Type: ☐ Beam ☒ Column

Boundary Conditions: Simple/Simple

Length (L): 4 m

Load (N,fi): 100 kN

☒ Temperature dependant imperfection (EN1993-1-2)

☐ Fixed imperfection (X¹, 4.8 · 10⁻⁴)

BOUNDARY CONDITIONS

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

Please select a fire type:

☐ No fire (20°C)

☐ ISO834 Standard fire curve

☒ DS Parametric fire curve

Resistance time: min

Opening factor (O): 0.02 m/s

Thermal inertia (b): 800 J/m²·s·K

Fuel load (q): 200 MJ/m²

Plot fire curve

FIRE DATA

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

Please select a calculation criteria:

☐ VERIFICATION - for the given resistance time (Returns the load-bearing capacity)

☒ DESIGN - for the given load (Returns the needed insulation thickness)

Calculate Plot steel heating Print Report

Insulation material:

☐ None

☒ Box encasement Gypsum board

☐ Contour encasement

Material data

RESULTS

Section data:

Cross section class: 4

As: 8.45 · 10³ mm²

Iy: 231.28 · 10⁸ mm⁴

Iz: 13.29 · 10⁸ mm⁴

W_{el,y}: 1156.42 · 10³ mm³

W_{el,z}: 147.63 · 10³ mm³

W_{pl,y}: 1307.15 · 10³ mm³

W_{pl,z}: 407.4 · 10³ mm³

Calculation results:

T_{s,max}: 856.0 °C

T_{cr,y}: 789.0 °C

T_{cr,z}: 708.1 °C

Req. Thermal resistance: d/λ_y: 0.038 m²·°C/W

d/λ_z: 0.085 m²·°C/W

Insulation thickness: d_{ky}: 9.8 mm

d_{kz}: 20.6 mm

Dynamo Player

SEID-BIM Export from Revit

Inputs needed

EXPORT

Select Model Element:

Nothing selected.

Directory Path:

Browse...

C:\Users\lorbel\Desktop

File name:

Carpark.rvt

Dynamo Player

SEID-BIM Import into Revit

Ready

IMPORT

SteFi's output:

Browse...

Desktop\Carpark1.xlsx\...

Carpark.rvt

MATERIAL

Stainless Steel

Steel, 45-345

Steel, Carbon

Identity Graphics Appearance Physical Thermal

GEOMETRY

Dimensions

b: 300.0

h: 340.0

r: 27.0

tw: 12.0

tf: 21.5

Routine for profile identification

Fire Protection

Sollicitant load in fire: 20.00 kN/m

Load-bearing capacity: 20.00 kN/m

Fire type: DS Parametric fire

Resistance time: 69 [min]

Opening factor: 0.04 [m²/(1/2)]

Thermal inertia: 1160 [J/(m²·s·K)]

Fuel load: 200 [MJ/m²]

Thermal resistance: 0.086 [m²·°C/W]

Hosted insulation ID: 868478

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