Preliminary research results of inter-disciplinary analysis of Kornati fire accident – conclusions and recommendations

Presented on Workshop

„ Forest Fire Behavior Research and Kornati Fire Accident – Facts and Preliminary Research Results“

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Conclusions

- Instead of classical conclusions we can try to reconstruct possible scenario:
  - Four hours after ignition the fire front reach the Sipnate canyon and fire enet the canzon from the SE part of hill Veli vrh.
  - After reaching the canyon axis the eruptive fire behavior starts. The consequence was that the whole canyon botton burned in relativlz short time (less than 1 minute).

Conclusions

- It is possible, according to aerodynamic analyses that, at the canyon bottom the turbulent boundary layer with maximal height of 2.5 m was formed.
- Eruptive burning of vegetation together with turbulent boundary layer could be a trigger for thermodynamic effect called „**the fast heat shock**“.
- The fast heat shock is formation of 2.5 m thick layer of heat air whose temperature was up to 300^{o}C and duration several minutes.

Conclusions

- The consequence of the fast heat shock could be temperature at the place of accident from 145 - 253 ^{o}C, duration between 234 – 251 sec with heat power 504 – 989 kW/m^{2}.

Racomandations

- Our investigation report finished with 37 recommendations whose goal was to improve fire fighting in Croatia.
- Recomandations were devided in three groups:
  - Recommendations connected with open-space fire behavior research.
  - Recommendations connected with fire fighters education.
  - Recommendations connected with fire fighting operative works and open-space fire protection.

Possible fire phases on site based on air flow assumption

1. Phase – site preheating
CONDITIONS:
Fire:
- Expected development

Flow:
- - lower winds, main flow SE, secondary flow through walley S
- - usual formation of aerodynamic flows (velocity distribution over sea and on walley entery, slightly exposed aerodynamic boundary layer
- complex terrain, speed-up effect,

INCIDENCE
Characterized by incidence that:
- nearby at the same time:
- bottom fire line reach first mid-walley grass
- upper fire line reaches plateau above site

OUTCOME
Formation of rising upward flow. Main flow characteristics:
- slow speed on walley axes
- expected grass burning speed

INDICATION
- Begining of the hot air cummulation. Trees burned up to 0,7 m height.

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2. Phase - critical
CONDITIONS:
Fire:

- Fire line reach high grass area
- Unexpected and stohastic development

Flow:

- faster winds, main flow SE , secondary flow through walley S
- unusual formation of aerodynamic flows (velocity distribution over terrain following walley entery, very exposed aerodynamic boundary layer
- complex terrain becomes simple, stone wall appearance,

INCIDENCE

- bottom fire line reach high grass
- developed upper fire line caused additional pressure drop

OUTCOME
Further development and speed up of rising upward flow. Main flow characteristics:

- moderate speed on walley axes
- global rotation of air by alongside walley axes caused by flow over two hills
- unexpected grass burning speed
- possible singularity effects formation

INDICATION

- Development of the hot air cummulation. Progresive burning. Trees burned up to 1,8 m height in the middle of the walley.

Possible fire phases on site based on air flow assumption

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3. Phase - terminal

CONDITIONS:

Fire:

- Fire line jump over high grass area
- Peak flow development

Flow:

- faster winds, main flow SE, secondary flow through walley S
- thermal boundary layer formation (velocity distributions arised by dominant thermal inputs)
- simple terrain with high roughness, dispersion of singularities and thermal boundary layer thickening
- localised backward flows over layer caused by continuity (causing noise)

INCIDENCE

Characterized by incidence that:

- nearby at the same time:
- bottom fire line reach high grass
- developed upper fire line caused additional pressure drop

OUTCOME

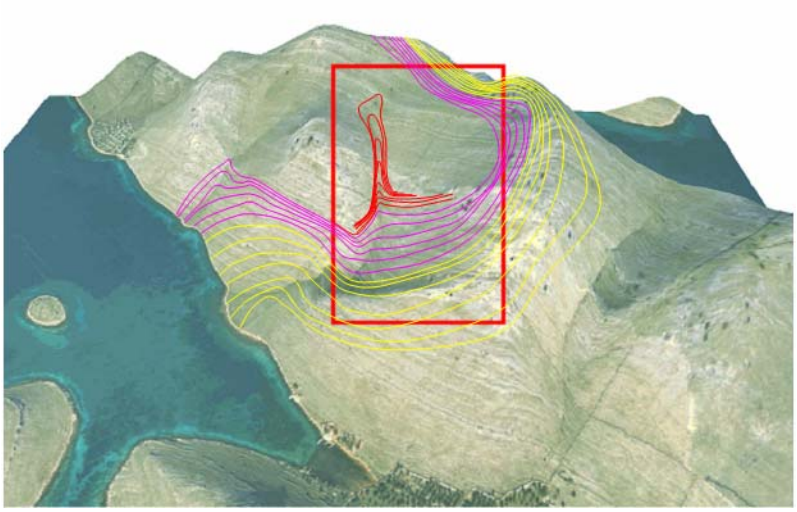
Further development and speed up of rising upward flow. Main flow characteristics:

- moderate speed on walley axes
- unexpected grass burning speed
- possible singularity effects formation

INDICATION

- Extreme development of the hot air cummulation. Further progresive burning. Trees burned up to 3 m height at the end of the walley. Firemans injury.

Possible fire phases on site based on air flow assumption



Possible fire phases on site based on air flow assumption

4. Phase – burn out
CONDITIONS:
Fire:
- Expected development
- Further fire progress

Flow:
- fast winds at the plateau, SE, secondary flow dissapeared
- thermal boundary layer stabilisation (velocity distributions predictable)
- moderate complex terrain, high roughness

INCIDENCE
- fire line reach plateau

OUTCOME
Main flow characteristics:
- high speed on plateau

INDICATION
- Fire jump over some areas. Some grass untouched. Wide site area burned out. Local heat development. Aluminum flange melting.

Possible fire phases on site based on air flow assumption