
UC
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND
Modelling of Pulsating Post-flashover Compartment Fires
Charles Fleischmann & Po-Hao (Andy) Pan

"Tell me a fact and I'll learn. Tell me the truth and I'll believe. But tell me a story and it will live in my heart forever." Indian Proverb

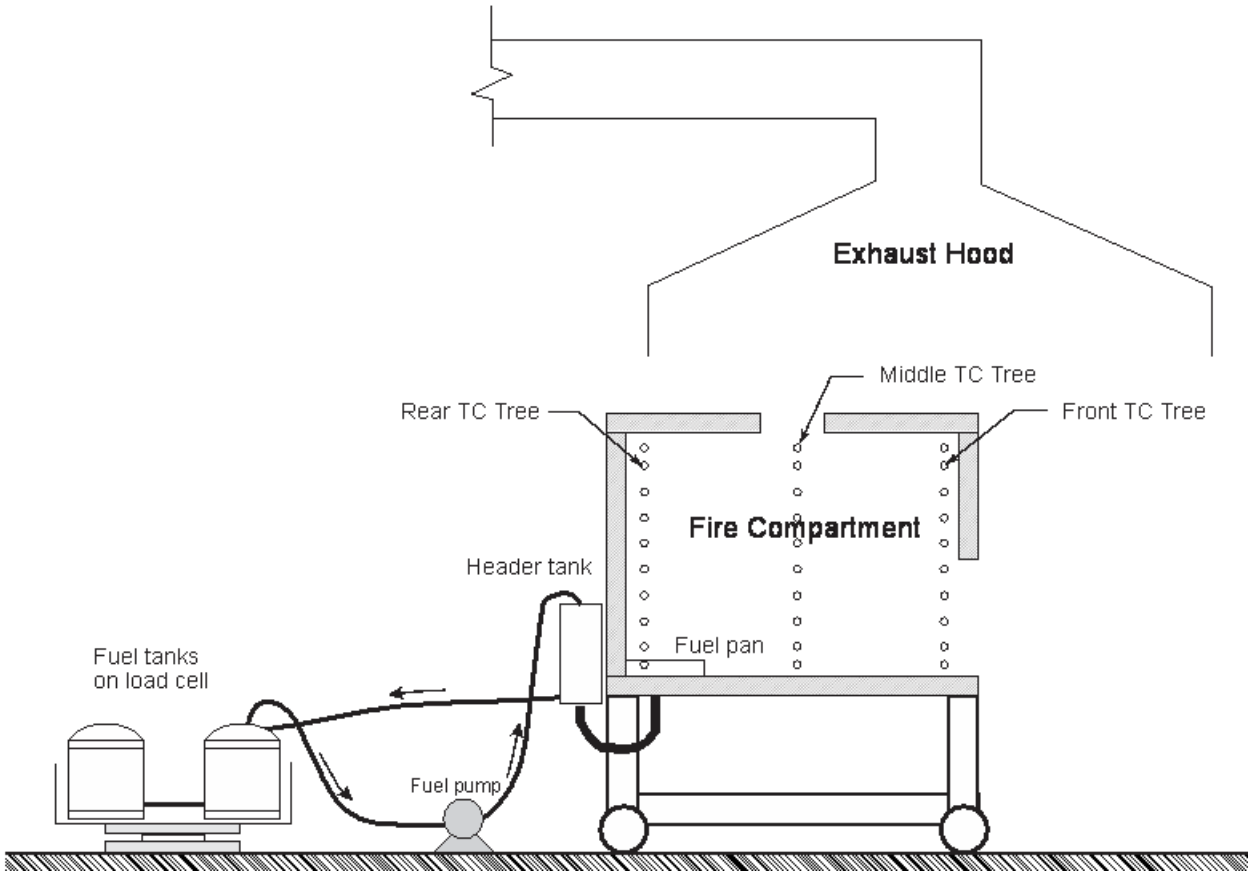
What is this story about

- 2001 - Experiments – Ee Yii
  - Post-flashover fire temperatures
  - Wanted to develop a simple model for compartments with wall vent and ceiling vent
  - Wanted to validate his model
  - Unexpected happened

What is this pulsing

Yii's experiments really detailed

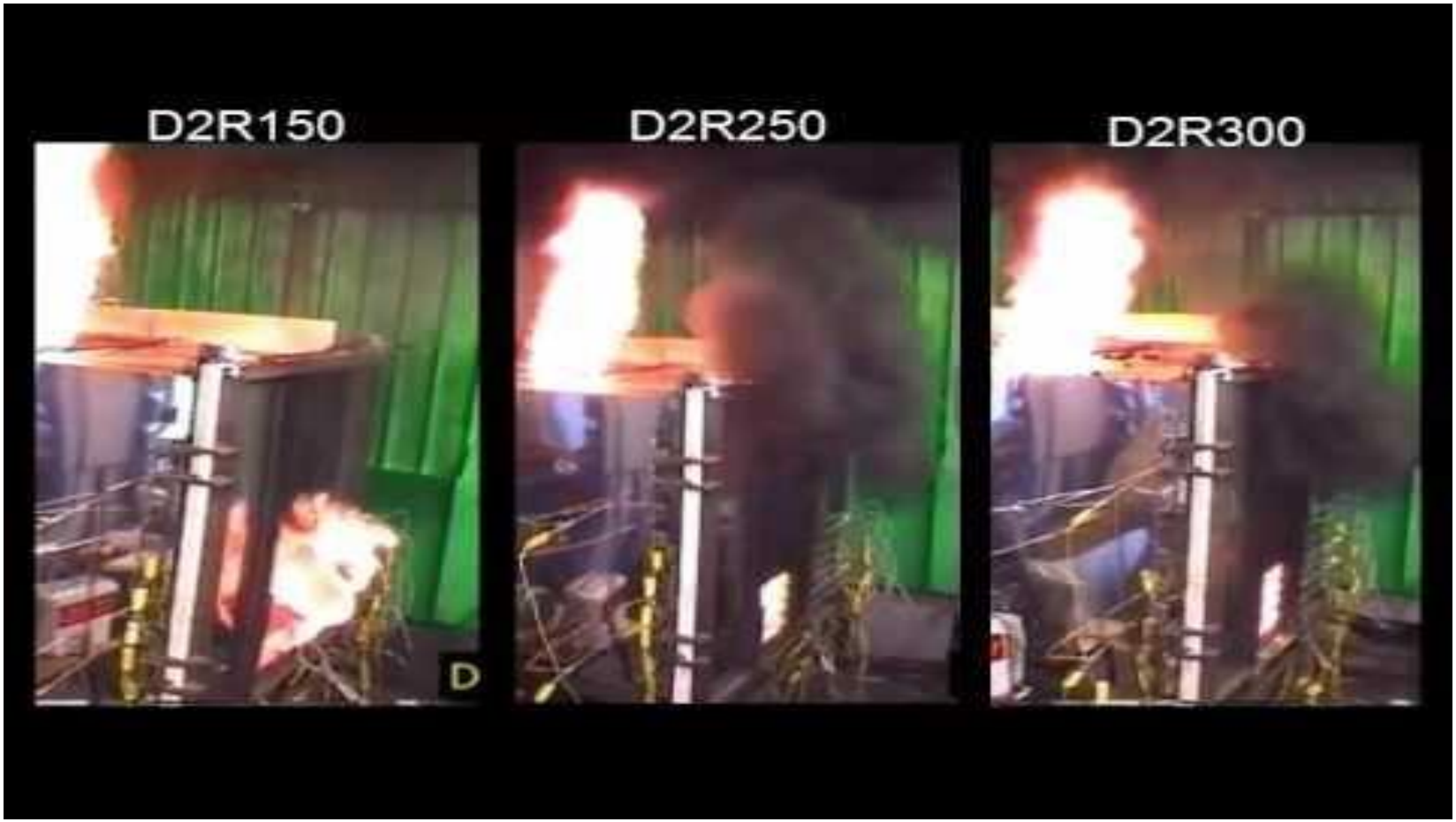
- Thermocouple trees
- Vent flows
- Mass loss



Vent sizes

Door Opening	Roof Opening Diameter					
	0 mm	**150 mm**	**250 mm**	**300 mm**	**350 mm**	**400 mm**
Door 1 **H: 450mm** **W: 250mm**	(D1R0)	(D1R150)	**(D1R250)**	(D1R300)		(D1R400)
Door 2 **H: 250mm** **W: 250mm**		**(D2R150)**	**(D2R250)**	**(D2R300)**		
Door 3 **H: 125mm** **W: 250mm**			**(D3R250)**	**(D3R300)**	**(D3R350)**	

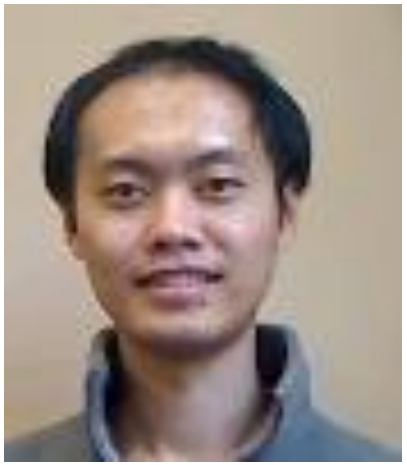
Obvious Pulsing Fires

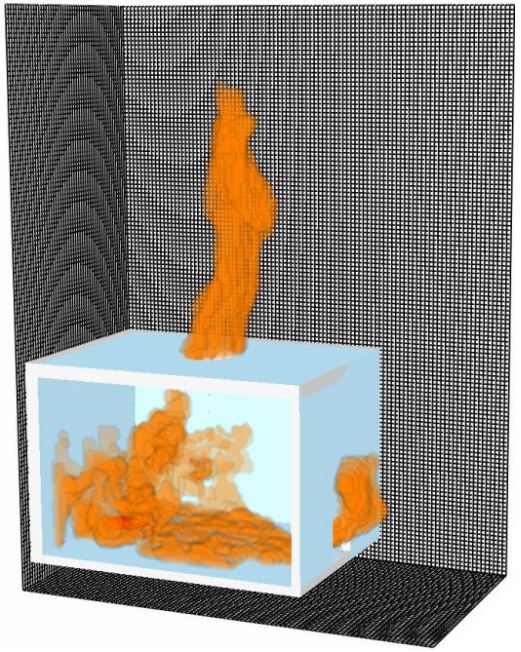


Not so obvious pulsing

Modelling pulsating fire

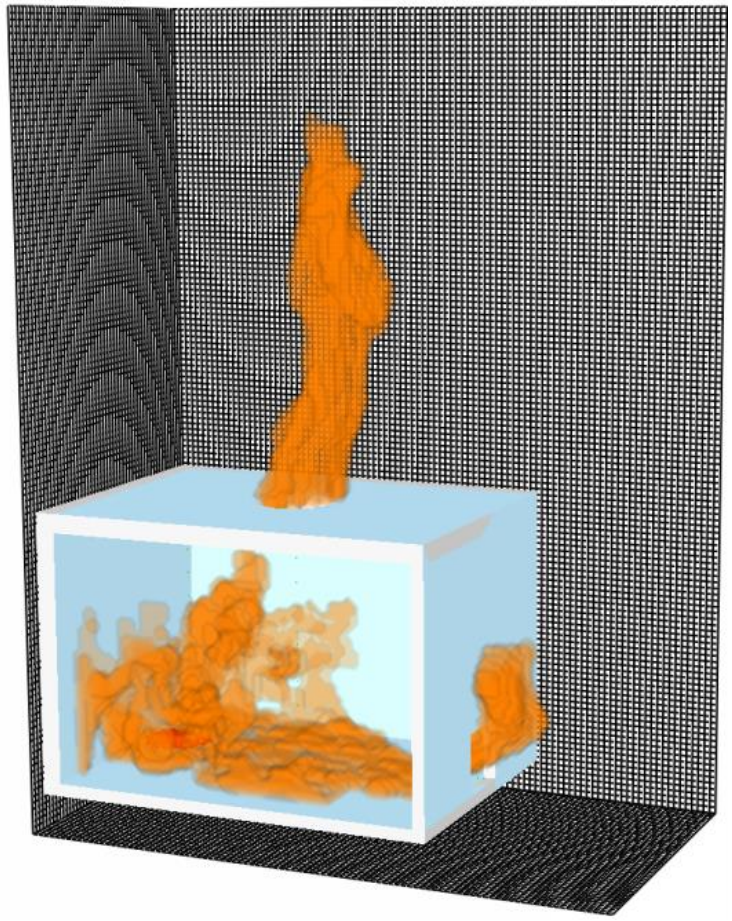
1. Po-Hao (Andy) Pan - Masters research project
2. Modelled Yii's experiments in FDS
3. Original work in FDS5
4. Delay
5. Work extended with FDS6



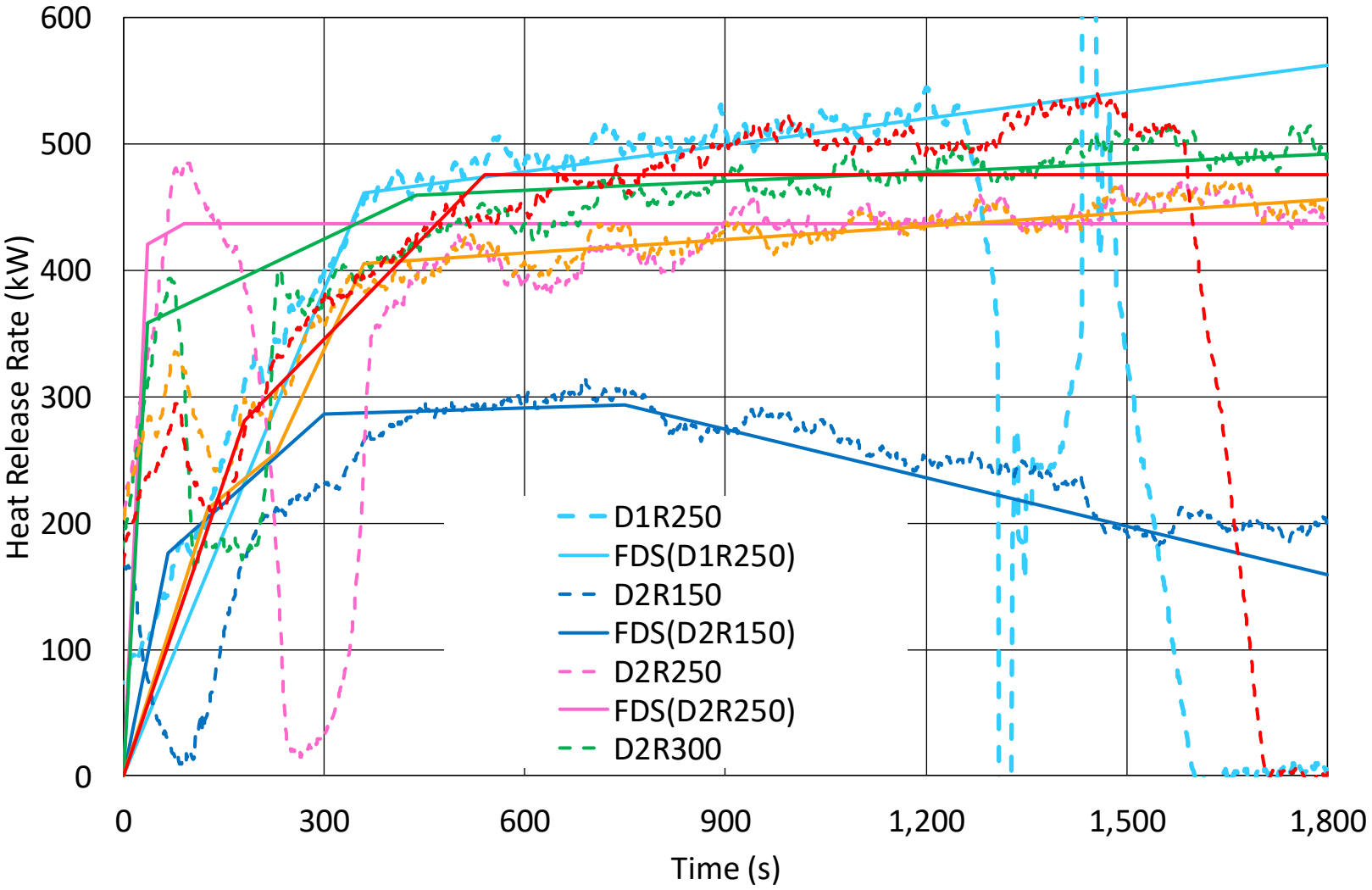


FDS Setup

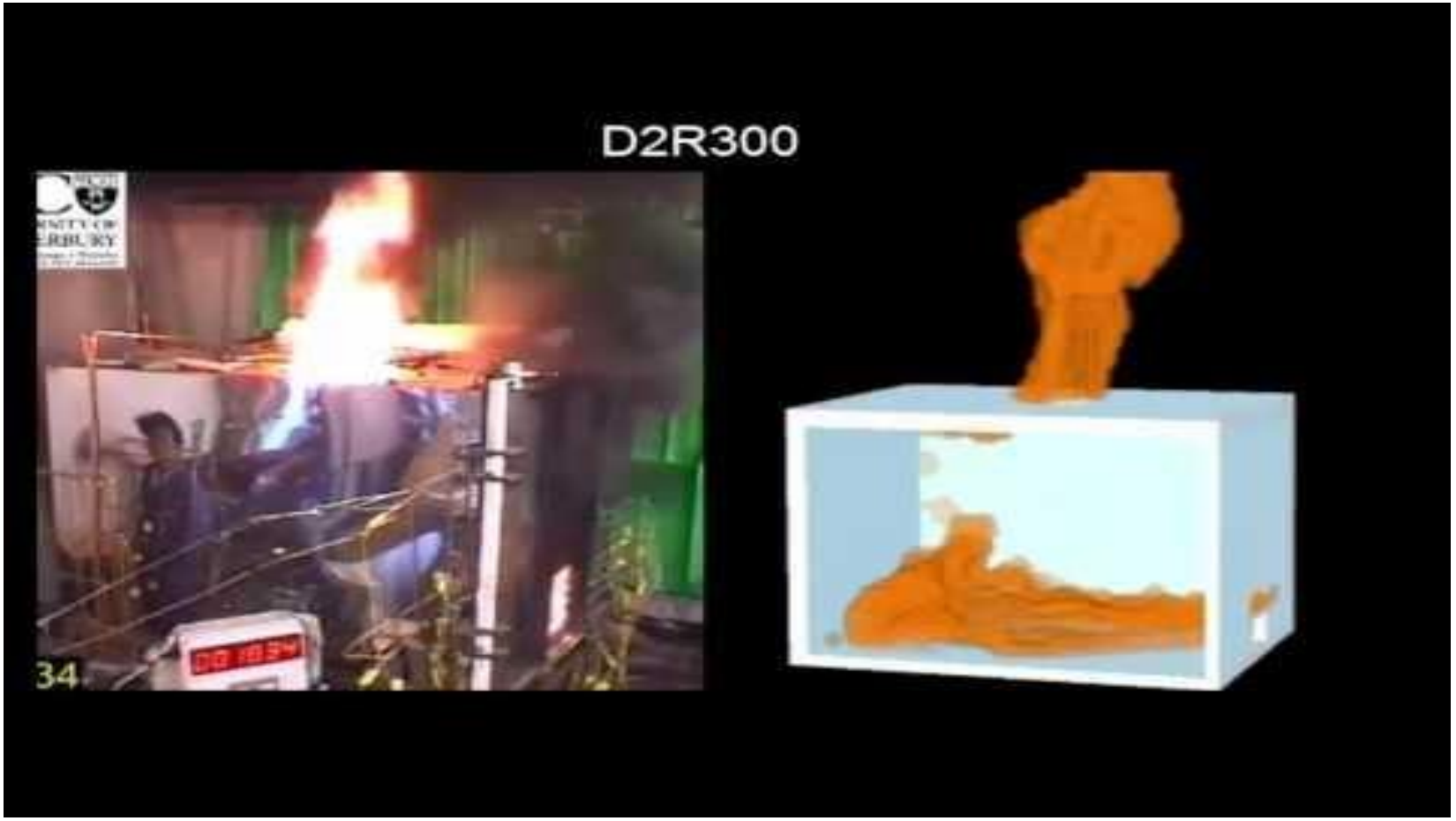
- Domain large enough to capture the external flames
- Specified heat release rate for the fire.
- No attempt to model the fire
- Thermal properties carefully modelled.
- 25 frames/second for videos



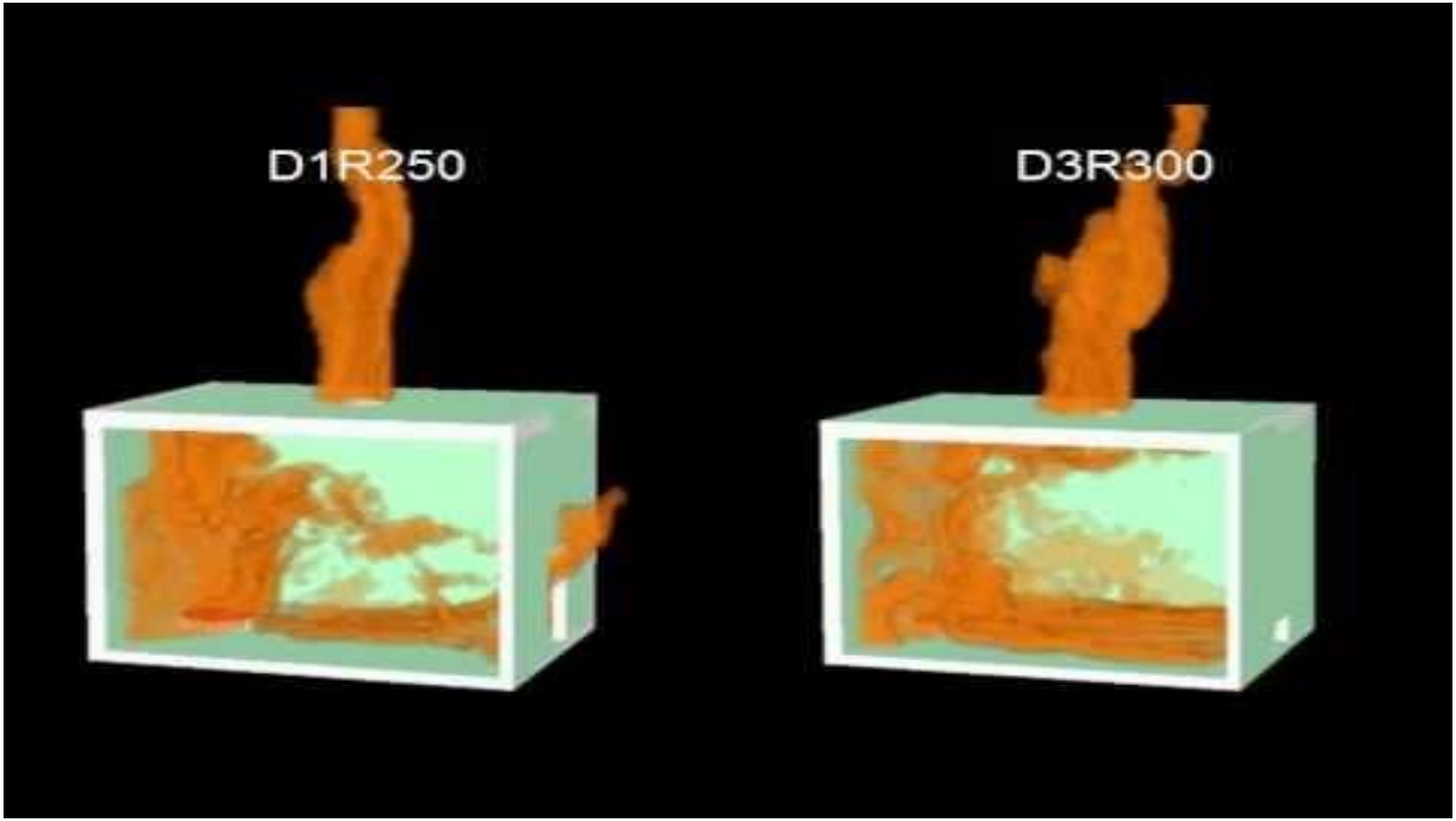
Fire curves based on mass loss rate



Typical pulsing in FDS



Pulsing near the limits



Quantative Results

Experiment #	Pulse Frequency (Pulses/min) Experiment Frequency	FDS6 Simulation Frequency	FDS5 Similation Frequency
D1R250	CF	CF	CF
D2R150	48	53	CF
D2R250	54	47	56
D2R300	55	48	64
D3R250	64	FI	72
D3R300	(57) DD	FI	72
D3R350	FI	FI	FI

CF – continuous flame in wall vent

DD – difficult to distinguish

FI – only inflow thru wall vent

Conclusions

- FDS6 can model pulsing behaviour
- Pulsing frequencies are within 20% of experimental results
- Yii's work could be more comprehensively modelled including analysing the compartment temperatures and vent flows?
- Beyond the specified heat release used in this study, future work could look at predicting the heat release rate from the pool fire.