



STRUCTURAL FIREFIGHTING

KNOWLEDGE BASE
ARTICLES

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What is Compartment Fire Behaviour Training (CFBT) – A change of culture.



‘One hundred years of tradition, unimpeded by progress’

This is how the fire service was described to me one day by a colleague from the US. I like it; and so do those that hear it from me. Never have I been taken to task except by the firefighter who said without a hint of a smile, that it was actually, ‘Two hundred years of tradition, unimpeded by progress’.

Touché.

What makes a firefighter smile when he or she hears their occupation described as such? Without a doubt we all share a romantic link with the past. We pay homage to those that preceded us; those that did the job hard and without the advantages of modern equipment and protective apparel. Similarly, on a more personal basis, we enthusiastically enter into discussions of how we did things in ‘good old days’ while junior firefighters shake their heads in disbelief, looking forward to the day when their turn will come to talk the talk.

So, what did I have to offer after years of fighting fires? I certainly considered myself a ‘successful’ firefighter. Simplistically every fire I had been to was out and I had escaped serious injury. I must be doing something right. But there were always those times that stuck out in my career to date, where I was definitely ‘lucky’; a yard further to one side or a couple of seconds later and who knows what would have happened. Invariably during the debrief after these incidents, we all blamed the fire, after all being a firefighter will always have its inherent dangers. And anyway, it was tough in a debrief to describe circumstances that I didn’t always understand.



Entry gained...

One fire in particular will always stand out in my mind as such an occasion. It was a fire at an office furniture retailer in early 1990’s. I had been a firefighter for five or six years. The building was of concrete, steel and glass construction. The front was glass sliding doors that led into a showroom, packed with filing cabinets, chairs, desks and bookshelves. In effect a concrete oven with limited ventilation except through the front sliding doors. And with the address only a kilometre downhill from the Station, we got there fast.

On arrival we found this structure closed up with large volumes of smoke but no visible sign of fire. We immediately opened the front glass sliding doors to gain entry. Inside we found a highly cluttered showroom with pathways between the sale items, forming somewhat of a maze leading deeper into the structure. Firstly, we moved what we could out of the



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showroom and onto the street path to give us better access. Once this was done myself and another took the first 38mm hoseline in, in an attempt to locate the fire and make the first attack.

As we moved in, I took up the hose behind the branchman. With no sign of fire or even a glow to guide us, we made our way in between the stacked furniture. I remember at that stage the smoke layer way above our heads and we were still able to progress standing up, deeper into the structure. As usual we were what I call, 'heatseekers'. With no sign of flame we followed the heat in an attempt to locate the seat of the fire. Above us though, was a dense black layer of smoke, completely obscuring the concrete ceiling and we could feel the heat being generated from it. It had also darkened considerably since our entry and was turbulent as it escaped from the front of the building.



One interior line of 38mm at work...

As we progressed further we were being forced lower by heat from above. I still remember trying to stay upright but the heat from above kept forcing us lower into a crouching walk. And still we held our water. Both of us sure of the fact that to open our branch indiscriminately at this time, would at the very least destroy what visibility we had and at worst produce a 'steam bath' that could make the environment untenable, and always in my mind was the old adage, "...and don't waste water on smoke'.

After advancing about 10 yards or so, and by now forced into a low crouch, we finally observed a glow to our left. The heat from above was increasing and as the branchman directed the first streams in that direction, we hunkered down tight to wear what we knew was coming, for there hadn't been a decent fire yet that I had fought where our first application of water didn't rob us visibility and increase the surrounding temperature. But we had finally found our target and it was time to give it all we had...



Fire gases begin to ignite as they exit the structure.

When I think back, it seemed only a short time since we had commenced our attack before I felt someone



pulling on our hose and yelling at us to pull back and evacuate. I turned and saw another figure behind me motioning us to follow. At this stage it seemed that a few things started to happen at once that ensured that we didn't need any further convincing that a retreat was in order.

Firstly our attack, if anything, only appeared to increase the intensity of the fire. Secondly, the smoke was now very low and very hot. It was rapidly



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becoming harder and harder to stay low enough to protect our unprotected necks.

We dropped the hose and followed it out as quickly as we could. I remember exiting the building to find TV cameras and media filming our 'tactical' retreat. I slowed up, made out I was in total control of the situation, dusted myself off and then turned to view the building. The furniture that we had pulled out into the street was giving off 'steam'. Obviously someone had wet it down. Now as I looked at the building, the smoke that billowed out had now turned, in an instant, to flame. Within in seconds the whole compartment that we had just occupied was fully involved! And then the 'steaming' furniture on the sidewalk also suddenly burst into flame. I remember thinking as I made my way to the BA truck to get a cylinder change, that the furniture that we had saved was now alight and how unprofessional that must look. Strange that my own narrow escape was not a real concern.

Once I reached the BA truck, I still remember the officer in charge of the Tally Board who asked me, 'did you throw that one in fire so that you can get a new helmet?'. I didn't have a clue what he was talking about until I took my helmet off and surveyed the damage. The majority of the top of the helmet had bubbled and melted with one side now melted and drooping down. And yet I did not have any injuries to my unprotected neck or face. It soon became evident that a great deal of heat was being projected directly down from above as we had advanced to the fire and commenced our attack.



Fully involved, minutes after withdrawal.

So, what did I learn from that experience? Or was it just another occurrence that did nothing more than reinforce that fact that we did a dangerous job? Did an incident like that better enable me to pass on life saving knowledge to a junior firefighter? Unfortunately, no. Experience without knowledge is a dangerous thing. Just as knowledge only without valid experience can also lead to disaster.

'There is no such short cut to proficiency in any profession and the day will come when your fellow countrymen will be obliged to open their eyes to the fact that, as a man learns the business of a fireman only by attending fires he must of necessity learn it badly. Even that which he does pick up and may seem to know, he will know imperfectly and be incapable for imparting to others.' (Sir Eyre Massey Shaw 1876)

Sir Eyre Massey Shaw may as well have been referring to yours truly. In fact I had nothing to pass on to the firefighter next to me. So I would say, put on your SCBA, grab a hose and follow me in. If it gets hot, get lower. In fact there are times when you may need to crawl towards a fire. The only thought going through my head was that as long as I can find the fire everything will be alright. If I can see it, I can deal with it. I was a 'tunnel visioned heatseeker'. And that is what I had to pass on. To date it had served me well. The only real validation was that I put fires



Author's helmet after the fire.



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out and was in one piece so I would continue that process and also pass it on to others. In other parts of the Brigade other 'experienced' firefighters also passed on their work practices...

A Change in Culture

Ten years later after returning from Sandö National Fire College Sweden and the County Brigades of Cornwall and Devon in the UK, I sat with my Region's Training Manager, a Officer I had served with for many years as firefighters and we had both gone to that office furniture fire. In fact he was first to observe the ignition of fire gases that led to our withdrawal, so I suppose I owe him a drink for that one. As we sat there I explained to him the concepts of Compartment Fire Behaviour Training as we looked at images and videos that I brought back with me. He had by this stage been in the Brigade for over twenty years and I can still see him now, repeatedly banging his hand down hard on his leg as he exclaimed, *'I knew there was a better way!'* It is a comment I heard frequently as we rolled out our own CFBT program over the last two years.

Experienced firefighters would tell us that they had experienced many of the phenomenon that we talked about but did not understand why or what may be coming next. And this wasn't because they hadn't been taught fire science while student firefighters at the Training College. It just wasn't made relevant.

To me, CFBT is the mechanism by which we strive to provide every firefighter with the necessary understanding of fire behaviour, combined with realistic training in proven and practical techniques, that will enable them to safely and efficiently extinguish structural fires under varying conditions. Implicit in the above definition is the application of 3D Water-Fog hose stream techniques using adjustable fog nozzles; techniques that were developed and pioneered by Swedish and British firefighters in the mid 1980's. During this time, CFBT Instructors began using basic steel shipping containers, loaded at one end with timber, to replicate the production of flammable fire gases, with open and shut vents added to control air flow.



Inside these 'containers', firefighters could not only view the early stages of fire growth but examine first hand the production of unburnt products of combustion combining with flammable gases given off by the pyrolysing timber. Firefighters were able to witness the transformation of smoke to flame as pockets of unburnt fuel in the smoke reached ignition and turned to flame. Using their hose-line, they would direct short pulses of water fog into these gases, lowering their temperature and causing any flames to disappear. As they cooled the gases, the layer of fire gases would contract away from them, maintaining their visibility.

Under the watchful eye of their instructor, they would practice their techniques, always observing the variance between too much or too little water, mindful of the steam generated if they misdirected their pulse against the superheated linings of the cell. These are the skills that they would take to their first fire call.



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'In order to carry on your business properly, it is necessary for those who practice it to understand not only what they have to do, but why they have to do it; and the whole course of my instructions is framed to lead to this end. No fireman can ever be considered to have attained a real proficiency in his business until he has thoroughly mastered this combination of theory and practice.' (Sir Eyre Massey Shaw 1868)

I have no doubt that Sir Eyre Massey Shaw would have welcomed the introduction of CFBT or in his words the, '... combination of theory and practice', that is CFBT. To me the true value and effectiveness of CFBT should always be measured on the fire ground. In other words how would firefighters that have completed CFBT fight a fire differently to those that hadn't? To examine that, let's look at that office furniture fire that proved to be such a close call.

A Different Way

Before we even entered there were certain signs that should have alerted us to the potential dangers of this particular fire. Initially (image I), there was no sign of fire and the smoke was lighter in colour. This tells us that there is plenty of pyrolysis still occurring due to the heat inside the structure but actual combustion has died back - not doubt due to the fire being in an under-ventilated state. The fire is therefore 'ventilation controlled' and what we do with our ventilation strategies will have a direct effect on



how it will behave. At worst we could have been looking at a backdraught situation or at the very least an intensification of the fire.

On that day we ignored these signs and opened the sliding doors to their full extent allowing the fire the oxygen that it needed. The smoke darkens telling us that more rich combustion is now taking place. The fire is getting what it needs!

Without the knowledge to tie in the changing smoke colours, we advance into the structure. At this stage Compartment Fire Behaviour Trained (CFBT) firefighters would be careful to manage this air way especially since there was no option to ventilate at a high point. This front entrance would become both inlet for air and outlet for combustible fire gases. It should have been seen as an extremely dangerous place, but as the images show, it became nothing more than a 'staging area' for other firefighters waiting to enter the structure.

Once inside we did nothing to control our environment, and in fact, believed that we were doing the right thing in not opening up the branch prematurely. And yet the true danger to us at that stage was the ignition of these gases as they were brought to their ignition temperature. In effect we were in a race to see if we could put the fire out before that happened. So what was happening around us meant less than getting to the fire as soon as possible.

Conversely, CFBT firefighters would be utilising their gas cooling hose stream techniques from the moment they entered the structure. By using the right amount of water, with the right droplet size, placed in the right place, they would not only maintain the hot fire gases below their ignition temperature but actually contract and raise the smoke layer, improving visibility. In such a structure an aggressive gas



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cooling attack would be necessary, utilising longer pulses due to the large amount of hot fire gases and the relatively large volume of the structure. A CFBT firefighter knows that hot gases represent the potential spread of the existing fire as they heat up and ignite...

Yet traditionally trained firefighters continue to see the use of water fog inside a structure as a recipe for disaster. One only has to look at literature that adheres to this. So powerful is this sentiment, that there are Brigades that have resorted to smooth bore nozzles at the expense of a true gas cooling capability that is found in combination fog nozzles. It only tells me one thing, they have never been taught the correct hose stream techniques and have never controlled a fire in this manner, whether in training or at a real fire. They continue to confuse gas cooling hose stream techniques with an 'Indirect' fog attack that is usually used as an extinguishing application. The two are NOT the same.

Simply put, gas cooling is a specific and discreet cooling of the hot fire gases in order to control an environment as one progresses to the seat of the fire or carries out search and rescue. Implicit in that is maintaining the thermal balance and visibility. By doing so the firefighter can control the onset of extreme fire behaviour such as flashover and fire gas ignitions. Going hand in hand with this ability is the knowledge of how these phenomenon develop and to be able to recognise their signs and symptoms. The bottom line is, it either works or it doesn't. These techniques have been in use for over 20 years. Don't just let me or anyone else tell you. Seek the training and knowledge and put it to the test.



Conversely, an 'Indirect' attack is an attempt to create as much steam as possible in order to smother the fire by excluding oxygen, cool all exposed surfaces and hot fire gases, and therefore bring combustible surfaces below a temperature at which they pyrolyse. It makes use of the tremendous expansion of water as it turns to steam and by definition requires the user to protect themselves, usually by launching the attack from an adjoining compartment. It is an extremely effective method of extinguishment.

By not controlling our environment that day we ended up being in the wrong place at the wrong time. Our lack of knowledge (regardless of experience) left us without the ability to judge where, and how fast, this fire was progressing. In hindsight we were lucky to escape uninjured or even killed but we also failed to stop the rapid fire progress that ensued. A CFBT firefighter would have not only seen the following signs of impending flashover but initiated gas cooling hose stream techniques,

- Ventilated fire (once we had opened the sliding glass doors)
- Low, turbulent Neutral plane
- Increasing heat from above, forcing us lower
- Pyrolysis of combustible materials – especially synthetics and plastics but also timber products
- Flames igniting in the overhead gases (first detected looking in from outside)



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All of these signs were present that day but to me they meant little. I was fighting the fire by 'routine', doing what I had always done. I was focussed on one thing, the seat of the fire and was lucky to beat a hasty retreat prior to flashover. That's not to say that a single hose crew was every going to necessarily deal with that situation. In fact multiple hoselines would have obviously been a better option for such an attack. But a CFBT firefighter would have been controlling the environment allowing him/her to know when conditions were deteriorating despite their constant efforts, and would have looked at exit strategies long before it was necessary to have another firefighter enter to tell them to leave. For there will always be situations where we have no alternative but to go defensive.

There is no doubt in my mind that a firefighter trained in the principles of gas cooling and environment control coupled with realistic fire behaviour knowledge and effective hose stream techniques is not only a safer firefighter but a more effective one. CFBT Firefighters, the world over, are not just reacting to fire, but now taking control. Control that comes with a better understanding of what is happening around them.

Credits : Images of fire scene by Martin Grant.

