

# **ALTERNATIVE SOLUTIONS FROM HELL !**

## ***A Contractor's Perspective***

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### **ABSTRACT**

The ability to be flexible in building design makes Alternative Solutions very appealing to Architects and their clients. While there may be positive aspects to adopting Alternative Solutions they can also be the cause of many problems both during implementation and ongoing maintenance of the building and its fire safety systems.

The problems that arise from specification of an alternative solution generally fall into the domain of the installing and/or maintenance contractor to resolve to 'make it work'. One of the main issues that arise is verification of compliance, where no one, the fire engineer included, can fully verify compliance of the proposed or installed system against the requirements of the alternative solution. Similarly during the buildings lifecycle the same issue around verification of system compliance arises when the system(s) cannot be readily verified against known codes and standards. Furthermore many alternative solutions can increase complexity for ongoing maintenance, increasing lifecycle cost and reducing the likelihood of continued compliance.

Alternative building solutions (Alternative Solutions) to prescribed codes and standards have always existed, traditionally as 'dispensations' from those codes and standards and more recently as a legitimate starting point for building design.

Since the introduction of the 1996 version of the Building Code of Australia (BCA) Alternative Solutions have become ubiquitous with it becoming increasingly rare to find a building constructed strictly in accordance with all deemed to satisfy provisions. Prior to this Alternative Solutions were generally reserved only for 'special' buildings which did not fit with well with the prescribed codes.

While prescriptive codes and standards can provide certainty in outcome, they are often inflexible, inefficient and cannot possibly cater for all possible combinations and permutations of a building design. Alternative solutions can also take into account other aspects of a building such as in use management which are not generally considered by system codes and standards.

However the benefits of alternative solutions are often eroded in wasted time and effort resolving issues arising from lack of clarity about what the alternative solution(s) require. This paper discusses issues around implementation of alternative solutions from a contractor's perspective and how they may be better documented for the benefit of all parties.

## BACKGROUND

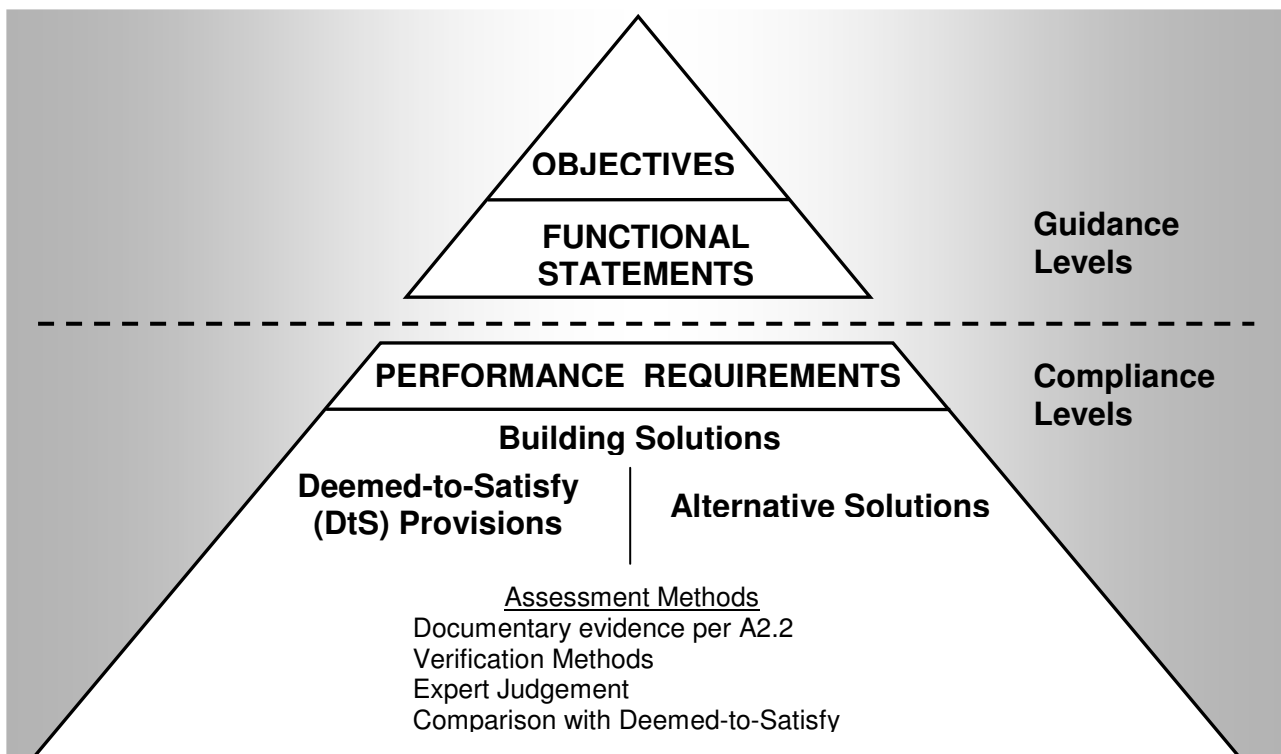
Like most regulations, building regulations and codes were developed to provide a minimum set of technical requirements to meet community expectations for the safety and amenity of newly constructed buildings. Some of the very first building regulations were entirely performance based with the only requirement being something to the effect that *“if the building collapses and kills the occupants, then the death penalty would be applied to the building designer(architect).”*

In the developed world building codes have developed to include many technical provisions relating to safety of constructed buildings, quite often in response to significant disasters. For instance building code requirements for fire separation within and between buildings were developed as a response to the Great Fire of London in 1666.

In Australia, technical building requirements were traditionally contained within state and local government building control regulations and by-laws, with each jurisdiction having it's own requirements, sometimes similar and often different. However over 20 years ago the Building Code of Australia (BCA) was developed as a national building code to replace the local building regulations and local government construction by-laws. It was the first stage of microeconomic reform, introduced with the intent of having a single, consistent set of rules for constructing buildings throughout Australia. This objective has largely been achieved, however a number of state specific variations still exist within the BCA as well as specific provisions in some state building and planning regulations.

Because the BCA was developed as a national document to replace technical building requirements in local regulation, it was initially a prescriptive only document, essentially describing a set of requirements to be applied for different buildings in different circumstances. If an architect, designer or building owner wanted to design and construct a building which did not fit within the prescribed requirements then an application for dispensation needed to be made to the relevant Authority Having Jurisdiction (AHJ) such as the municipal council or state based building control authority and/or various reporting authorities (eg Fire Brigade, Utilities, etc).

In the second stage of microeconomic reform relating building construction the BCA was modified to become a performance based building code. It was restructured such that a relatively small number of Performance Requirements were the only mandatory requirement of the BCA. These performance requirements are based on objectives and functional statements at the start of each section of the BCA. The 'old' prescriptive requirements are still included as a set of technical requirements that are “deemed to satisfy” the performance requirements. This is commonly represented as a pyramid structure as shown in Figure 1, below.



either by adopting the DtS provisions, developing an alternative solution or a combination of both. An alternative solution is defined as "a building solution which complies with the performance requirements of the BCA, other than by reason of satisfying the Deemed-to-Satisfy (DtS) provisions." Thus any approved building solution which does not fully comply with the DtS provisions is an alternative solution.

DtS building solutions can be applied "as of right" without any further justification, however should a building designer wish to utilise an alternative solution, they need to demonstrate that it does comply with the relevant performance requirements. The BCA allows a number of ways in which an alternative solution can be demonstrated to comply, namely

- By demonstrating absolute compliance; or
- Demonstrating equivalence to the relevant deemed-to-satisfy provisions; or
- By utilising a verification method provided in the BCA (if applicable)

One of the issues that arises in demonstrating compliance with the performance requirements is that the required performance is not quantified, rather defined in a qualitative statement. For example the performance requirements for fire isolation of exits, DP5 starts with...

"To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to....." .

And then lists a number of un-quantified criteria in which to consider "to the degree necessary".

In a small number of circumstances there are defined verification methods (for example CV1 & CV2) which can be utilised as a quantitative demonstration of compliance, however mostly

demonstration of compliance with the performance requirements is subjective. Thus when an alternative solution is undertaken for compliance with the Building Code of Australia a formal Fire Engineering Process, such as that documented in the International Fire Engineering Guidelines, should be followed.

The third stage of building construction microeconomic reform that has occurred in most state jurisdictions since the introduction of the performance based BCA is privatisation of the statutory building approval functions traditionally carried out by local government authorities. This means that application for building construction approval (eg building permit, development application, etc) can be sought from a private registered building surveyors (building certifiers) instead of applying to the building and planning dept of the local council. When a private building surveyor is engaged to carry out the building approval functions, they become a statutory authority for the purposes of that particular building and the relevant local government's role is generally limited to storing and archive of relevant approval documentation, such as plans, specifications and permits.

## **DEEMED-TO-SATISFY VS ALTERNATIVE SOLUTIONS**

### **IS ONE BETTER THAN THE OTHER?**

The BCA permits either type of building solution to be adopted, in fact it also allows a combination of both DtS and alternative solutions to form the complete building solution. So the question "Is one better than they other" is a rhetorical question with the answer "It depends on the situation". The advantages and disadvantages of each are outlined below.

### **DEEMED-TO-SATISFY SOLUTIONS**

#### **Advantages**

The prime advantage of the DtS solution is that it is a known solution and can generally be adopted without further analysis or assessment. While there may be some design engineering required the parameters in which the design and installation must fit are standard. This often makes design, construction and maintenance of the building very straightforward as each party involved has a clear idea of what the system parameters & requirements are. This is particularly important for reliable installation & maintenance of fire safety systems.

Other advantages include

- Approval process is generally simpler.
- Have a greater tolerance for change in operation of the building without re-assessment.
- They are generally robust, with redundancy built in.

## **Disadvantages**

While the DtS provisions have some allowance for different building types and features they are typically a "1 size fits all" solution. The DtS building solutions are generally based around 'typical' homogeneous buildings thus often become very limiting particularly with unusual buildings. Also the deemed-to-satisfy provisions do not readily allow for new technologies or methodologies and due to the process required to change the DtS provisions, it can be many years for a change to be adopted and published from the time a proposal for change is submitted to the ABCB.

## **ALTERNATIVE SOLUTIONS**

### **Advantages**

There are a number of advantages of adopting Alternative solutions such as

- Can be very cost effective (one of the original reasons for introducing alternate solutions)
- Greater flexibility, utilising holistic approach.
- Ability to consider specific occupancy within a particular class of building (eg a warehouse storing stone products is a significantly different risk to a warehouse storing firecrackers).
- Ability to consider management in-use measures as well as physical measures.
- Can take advantage of 'tradeoffs' in increasing the performance various fire protection systems above their normally expected level.

### **Disadvantages**

Alternative solutions by definition are non-standard which is their biggest weakness. This has impact in a number of areas, including

- Ongoing inspection, testing & maintenance of the fire protection systems
- Minor/moderate changes in operations within the building
- Future modification to the building may require significant assessment to re-validate the fire safety strategy.

## **ISSUES ARISING FROM ALTERNATIVE SOLUTIONS**

### **GENERAL**

The concept of alternative solutions in considering a holistic approach to fire safety is very sound, however it is the practicality of many alternative solutions that result in problems either during construction or ongoing maintenance of a building. The result is often what the author terms an "Alternative Solution from Hell !". Although tongue in cheek, the reality is that, these days, many alternative solutions are impractical, illogical, overly complex and/or poorly documented.

Furthermore the current trend in construction of buildings is for reduced involvement of the fire safety engineer and systems designers, with reliance on individual installing contractors to 'make it work'. This all results in building fire safety solutions which are prone to failure and usually end up resulting in significant cost burdens during in-use management.

## **PRESENT DAY APPLICATION OF ALTERNATIVE SOLUTIONS**

The performance based BCA has been in use now for over ten years and as such the use of alternative solutions in newly constructed buildings has become commonplace. In fact it is rare these days to find a building constructed to BCA volume 1, which does not utilise at an alternative solution. This has meant that alternative solutions are now largely a commodity rather than being reserved for 'special' situations, and as such the robust Fire Engineering Process normally required is often rushed and not strictly followed.

The process varies slightly from project to project, but usually follows a process such as

- Building owner and/or developer proposes a new building and prepares a brief as to the specifying the general requirements of the building.
- A design team is engaged to prepare schematic design documents to the brief.
- A building surveyor (building certifier) will be appointed to review BCA / regulatory compliance.
- Possible alternative solutions will be proposed by the building owner, architect, designers and often by the building surveyor, based on past 'similar' projects.
- A list of "agreed" alternative solutions will be determined and a Fire Safety Engineer is engaged to assess the alternative solutions
- The fire engineering report is tabled to the design team and the client for review. Usually there is little comment or amendment.
- The design team incorporate any specific outcomes in their documentation and sometimes attach a copy of the fire engineering report as part of their documentation.
- The documentation is issued for tender, contract awarded and subsequently constructed.
- At the completion of the construction the relevant installing contractors are generally required to certify that the completed installation satisfies the relevant standards, the design specification & drawings and the fire engineering report.

In the author's opinion, there are a number problems which can arise from this process, such as

1. The building surveyor & services designers often have a vested interest in the success of the alternative solution because it affects their reputation and ability to win future work. This means that most alternative solutions are not critically reviewed objectively.
2. Much of the effort in assessing alternative solutions is put into "crunching the numbers" to justify the outcome with much less effort put into documenting the solution.
3. The fire engineers are often left out of the construction and certification process and the installation contractors often have very little understanding of the alternative solution.
4. The installing contractor's often have a very limited understanding of the alternative solution and often the alternative solution is a holistic outcome, relying on more than just one trade.
5. The traditional new building procurement process generally has little regard for ongoing maintenance costs, which means that many alternative solutions can introduce significant maintenance burden over the lifecycle of the building.

In short, one of the main factors that results in a poor alternative solution is the process and framework in which the alternative solutions are developed and implemented. It is often difficult to get DtS solutions implemented properly and an alternative solution is a greater challenge

### **ALTERNATIVE SOLUTIONS WITH LITTLE NET BENEFIT.**

As discussed in the first part of this paper is that alternative solutions have almost become a commodity. Because of this it is not uncommon to see adoption of alternative solutions with little net benefit seemingly just for the sake of it. It is almost as if the selection of such alternative solutions has been on the basis of "while I'm assessing these other alternative solutions I might as well assess this one also and save 2° on the construction cost". While there is nothing wrong with this approach from a theoretical viewpoint, practically it adds a layer of complexity, often resulting in additional costs during construction and particularly maintenance trying to sort out what the exact requirements are.

### **CAPABILITY OF INSTALLATION AND MAINTENANCE CONTRACTORS**

After an alternative solution has been developed by a Fire Safety Engineer, verified by a Building Surveyor, documented by a services engineer and tendered out by a Builder, it is the installing contractor that is left "holding the bag" charged with the responsibility of making it all work and at the end is expected to provide a compliance statement. Then once the building is completed it is the maintenance contractor that must maintain the system and certify its ongoing compliance.

The capability of an installation or maintenance contractor is largely dependant on the field staff installing or maintaining the various systems. And while most field staff have a thorough understanding of the practical requirements associated with maintaining systems or installing pipe and cables, they generally have a very limited understanding of a holistic fire safety strategy, particularly when that strategy departs significantly from known codes and standards.

Unfortunately in new building construction the traditional procurement approach of tendering work out to the lowest bidder with little regard for their ability to understand and successfully install an alternative solution is still applied.

### **UPFRONT AGREEMENT OF ALTERNATIVE SOLUTIONS**

One of the main disadvantages in adopting alternative solutions is that technically the viability of the alternative solution is not known until the engineering analysis is completed. However in the modern world with 24/7 instant answers building proponents demand the best of both worlds. Thus alternative solutions are often agreed upfront and the building designed and documented while the fire safety engineering analysis is being undertaken to prove the pre-agreed outcomes. This can result in some esoteric solutions required to justify these outcomes, particularly where the engineering analysis is marginal.

## **INSTALLATION SPECIFIC ISSUES**

### **Documentation of Alternative Solutions**

It is widely acknowledged that the quality of project design documentation across the entire spectrum of the building and construction industry has declined significantly over the past twenty years as documented in the recent report "Getting It Right The First Time" prepared by Engineers Australia Queensland Division Task Force report. It has become commonplace these days to find the fire engineers report appended to the project design specification, reinforcing the fact that the design documentation is not complete.

Because alternative solutions are a departure from known standards and norms clear concise documentation is critical. Poor documentation coupled with a contractor's limited understanding of the holistic fire safety strategy results in confusion and wasted time and resources trying understand and install or maintain the building solution.

### **Complex control strategies**

Some alternative solutions rely on complex control strategies which are great in theory but in practice rarely get implemented properly. It is widely known that the reliability of an AS1668 zone smoke control and pressurisation systems is drastically reduced as the number of controlled fans increases. And this is a known DtS standard building solution, when it comes to an alternative solution the probability of successful implantation is reduced further.

Apart from the fact that a complex control strategy is less robust, the main reason these fail is the decline in commissioning standards, which is akin to the decline in documentation standards discussed previously. We now live in a world where the only thing that matters is a single piece of paper provided by the installer to certify that "everything complies". Very few building proponents are concerned with witnessing commissioning tests or even receiving equipment & system commissioning records.

### **Fire Engineer not involved during construction**

Unless the building being installed is of some significance the fire engineer is often left out of the construction process, unless there is a specific requirement from the Authority Having Jurisdiction (AHJ). This relates to the previous issue around commissioning as the Fire Engineer would be very interested to know if the systems have been fully commissioned and operate as intended, particularly if they are required to 'sign off' that everything is installed and operating as intended.

### **Alternative solution referencing more than 1 standard with conflicting requirements**

It is not uncommon to find alternative solutions which reference requirements for two different conflicting standards. For example the statement "Provide portable fire extinguishers in

accordance with the BCA DtS and AS2444". The problem with this particular statement is that the BCA DtS provisions for portable fire extinguishers is a subset of what AS2444 would require, therefore such statements lead to confusion as to which requirement takes precedent. Also when it comes time for the installation contractor to certify the installation they may not be able to provide such compliance statement.

To specify the alternative solution properly only one installation requirement should be referenced, eg

*" Provide portable fire extinguishers in accordance with the BCA DtS provisions"*

OR

*"Provide portable fire extinguishers in accordance with AS2444"*

### **Reference to standards in inappropriate situations**

Quite often known standards are applied to alternative solutions inappropriately presumably as a means to strengthen the argument for the alternative solution because it is based on a known standard. For example consider the following requirement of an alternative solution

*"Provide smoke detectors within the concealed ceiling space in accordance with AS1668"*

While a seemingly straightforward requirement, the following should be noted:

- AS 1668 does not require smoke detectors within the concealed ceiling space, so an installation without any smoke detectors would 'comply'
- If smoke detectors are installed in the ceiling space, what are the spacing rules, particularly if there are many obstructions such as ducts and beams.
- What do the smoke detectors in the ceiling space do, ie do they start the smoke mode fans only, do they call the fire brigade, do they initiate the warning system, etc?

## **ONGOING MAINTENANCE**

### **General**

The secondary impact of "Alternative solutions from hell" is during the ongoing maintenance and in use management of the building. There are two main areas where their impact is noticed, increased maintenance costs and determination of compliance.

### **Increased maintenance Costs**

Many alternative solutions are geared around minimisation of construction costs, however this can often result in increased maintenance costs. A common example where this occurs is in alternative solutions which utilise enhanced fire sprinkler and/or detection systems to justify a reduction in Fire Resistance Levels. Although the FRL is reduced, the Fire Resistance elements still require the same level of maintenance at the same time the maintenance level of the sprinkler and detection systems is usually increased, particularly where floor by floor valving is utilised.

## **Determination of compliance**

During the lifetime of a building events occur which cause the compliance of a building to be called into question, such as a change of owner, insurance review, refurbishment or simply a change of maintenance provider. For buildings more than 10 years old it can often be difficult to simply determine what the deemed to satisfy requirements were at the time of construction, let alone and specific alternative solutions that existed. Technically the building documentation should be retained by the building owner and be readily available when such circumstances arise. Practically this rarely occurs and often significant resources are needed to track down the documentation or in many cases re-assess the alternative solutions.

The other aspect of this issue is the standard to which systems incorporating alternative solutions are maintained. Invariably Australian Standards, such as AS1851, are specified without modification as the required maintenance standard. When the maintenance contractor carries out the required inspection and tests on such system they must defect them as the maintenance standards are written around fully standards compliant installations. One must remember that the maintenance contractor does generally not have the skills to make judgement about what is acceptable, they can only make an assessment as to whether it complies with the specific requirements of the standard or not.

## COMMON ALTERNATIVE SOLUTION FAUX PAS

In summarising the main themes of this paper, it is useful to consider some examples of what the author considers to be faux pas which are commonly adopted as alternative solution.

- Use of Alternative solutions which have little net benefit and create compliance issues and confusion, eg Omission of sprinkler heads from small sections of the building comprising many thousands of sprinkler heads.
- Use of standards in inappropriate situations, eg "provide smoke detectors in the concealed space in accordance with AS1668".
- Undertaking Alternative solutions upon definitions in the BCA, eg the definition of "Atrium" and "Open Deck Carpark" are often 're-engineered'.
- Alternative solutions to "Alternative Solutions", eg use of internal window drenchers in lieu of providing fire compartmentation, then assessing an alternative solution to justify the installation of blinds in front of the window drenchers.
- Not specifying a year on design standards (becomes very important when trying to determine compliance at a later date).
- Specifying a number conflicting design requirements, eg AS2444 & BCA
- Specifying application of standards incorrectly, eg smoke seals to 1530.7, this standard relates to the whole doorset comprising the leaf, hinges, latch, etc, not just the seals.
- Generic maintenance requirements being applied in Occupancy Permit for systems which have departures from the DtS.
- Use of empirical / quantitative formulae in inappropriate situations, eg Alpert equation to 'predict' detector performance in spaces with beams, ducts, etc.. resulting in installations which don't make sense.

## CONCLUSIONS

While Alternative Solutions can provide more cost effective and flexible building solutions than DtS provisions, poor implementation has reduced many of these benefits. Alternative solutions are being overused or being used in situations for marginal benefit resulting in situations where determining system and building compliance is very difficult.

The best alternative solutions are those in which the system requirements match system standard requirements as closely as possible by adopting the KISS<sup>1</sup> principle. Such alternative solutions have a much greater chance of success both in the installation and in the ongoing operation and maintenance of the building.

It can also be reasonably concluded that one of the reasons Alternative solutions tend to be 'overused' is that many DtS provisions have little flexibility or options. A better approach would be to expand the suite of available DtS options available, for example having options to deal with different travel distances or different fire resistance levels contained within the DtS provisions. This would provide greater flexibility to architects minimising the need to adopt alternative solutions for minor matters, resulting in known, defined outcomes.

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<sup>1</sup> Keep It Simple Stupid