Context

- I Investigate Real Disasters (Technical/Legal)
  - Deaths from fires
  - Deaths from collapses
- I advise clients on operational safety critical issues
  - Melbourne Metro
  - Airport Link (Perth)
  - Airport Link (Montreal)
  - Ryhad Metro
  - Doha Metro.
Cross Passage Construction Fatality Risk

V.

Cross Passage Spacing Fatality Risks during Operations
- ONSR wins?

Professor Arnold Dix

1 November 2017
What is a cross passage?
TUNNEL CROSS PASSAGE
Why have a cross passage?
What spacing?

- **NFPA**
  - Rail: 244
  - Road: not more than 300M

- **AS4825**
  - 240 metre cross passages separation

- **EU Directive 2008/57/EC and EC Regulation 1303/2014** cross passages every 500 metres
Road

ROAD (Cross Passage Maximums)

• UK 100m
• AS4825  120m
• NFPA 502  -300m
• Germany 300m
• France 400m
• PIARC 100m to 500 m optimal
• China 250m – 500m
5 Values – at least 4 must be wrong?
NFPA 130

5.1.2.3 Cross-passages are not required in tunnel sections where the distance between evacuation shafts is less than 762 m.

5.1.2.4 In accordance with NFPA 130 (6.2.2.3.2), cross passageways shall be provided at a maximum distance of 244 m between each other or to another access towards a point of safety (evacuation shaft in tunnel or at a station end, tunnel portal).
Why that spacing?

• No one can exactly remember
• Perhaps in rail it relates to 600 feet long trains in early USA
• Perhaps 120 M for road tunnels is about segment lengths or fire hose lengths?
• Perhaps the 11th commandment?
• „perhaps” is NOT good enough
Procustean (Harry Asche)

- A Procustean solution is the undesirable practice of tailoring data to fit its container or some other preconceived structure.
- In a Procustean solution in statistics, instead of finding the best fit line to a scatter plot of data, one first chooses the line one wants, then selects only the data that fits it, disregarding data that does not, so to "prove" some idea. It is a form of rhetorical deception made to forward one set of interests at the expense of others. The unique goal of the Procustean solution is not win-win, but rather that Procrustes wins and the other loses. In this case, the defeat of the opponent justifies the deceptive means.
Reverse Engineering

• Whatever the reason – now people use it as a “special” number.
• Time/Temp
• Smoke
• Travel Times
If KPI were different

• Time to finish a level of candy crush
• Time to post 5 images on facebook
• Time to post a tweet
• Time to consume one standard “longneck” beer
• Distance you can throw a full stubby
Building Cross Passages
Construction Risk
Fire Authority

• Potentially Career limiting move to allow less cross passages (even if basis for standards unknown)

• Should not have to be a defacto approvals authority.

• How can AHJ make this call? (not fair)
Change NFPA 130?

A6.3.1.4*

The maximum distance between exits shall not to exceed 762 m (2500 ft). To avoid doubt this mandatory requirement is subject to the equivalency provisions in the standard and may be the subject of a risk engineering analysis which may demonstrate equivalency for an alternative distance to a point of safety. This alternative distance may be shorter or longer than the prescribed distance.
A-6.3.1.6

The maximum distance of cross passages from stations, portals and other cross passages is mandated as 244m. To avoid doubt this mandatory requirement is subject to the equivalency provisions in the standard and may be the subject of scrutiny using methodologies such as a risk engineering analysis. Such analysis may demonstrate equivalency for an alternative separation distance. This alternative distance may be shorter or longer than the prescribed distance.
Office of the National Rail Safety Regulator “ONSR”.

- duty imposed upon those who ‘design, commission, construct ... maintain ... rail infrastructure’ to manage risks:
- “... so far as is reasonably practicable ...”
- a. to eliminate risks to safety as far as is reasonably practicable; and
- b. if it is not reasonably practical to eliminate risks to safety, to minimise those risks so far as reasonably practicable.” (Part 3, Section 46 of the Rail Safety National Law Act 2012)
ONSR

• There is no requirement to strictly follow NFPA 130, AS4825:2011 or any other standard for that matter.
ONSR

• The issue is whether or not the resultant railway is, from a safety perspective, built and to be operated safely and that known risks have been eliminated so far as is reasonably practicable and to the extent it is not reasonably practicable to eliminate the risks they have been minimised so far as is reasonably practicable
Compliance

• Simple compliance / or non compliance with a standard is not the right metric
Practically

• In modern road and rail projects cross passage separation should, where genuinely necessary, be negotiable in separation distances.
Questions?