Cost-Benefit of Passive Fire Protection in Steel Framed Buildings

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INTRODUCTION

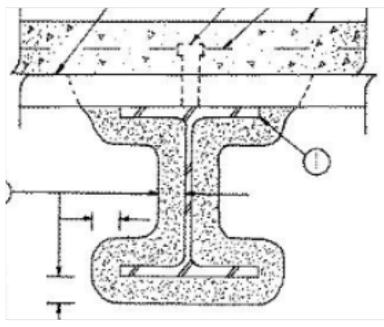
1991 Fire at One Meridian Plaza, Philadelphia, PA

Every building has a fire protection requirement based on the type of construction (occupancy, usage, etc.). Currently, a prescriptive approach is use to design fire protection of buildings. Performance based design, or structural fire engineering, is an emerging approach to fire protection which requires an engineer to have the primary role in design. This new approach could allow for fire protection to be optimized based on how the structural elements would perform under fire conditions. A realistic fire curve could allow for the reduction of passive fire protection on filler floor beams (i.e. secondary framing) and, ultimately, decrease construction costs and positively affect the construction schedule.

Goal: To assess the cost-benefit of passive fire protection applied to secondary framing members of a Type I-B office building.

METHODS

Ozone Program

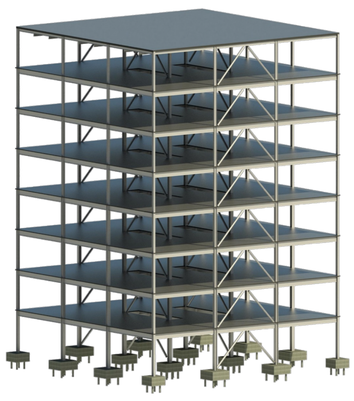


Gather building costs, plans, and information

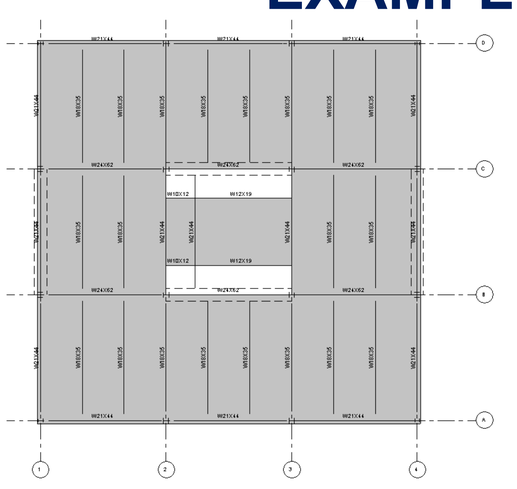
Estimate cost of overall fire protection and the contribution from primary and secondary framing members

Build a sample compartment in Ozone and compare exposure to fire curves with and without sprinklers.

Analyze data and evaluate fire protection on secondary framing members



EXAMPLE BUILDING



- ❑ Type I-B Construction
- ❑ 8-Story Mixed-Use Building
- ❑ 12 ft story-height
- ❑ 15ft x 15ft Compartment Size
  - ❑ Window Opening on 1 Wall
- ❑ 3 Secondary Framing Members:
  - ❑ W14x22, W16X26, W18X35

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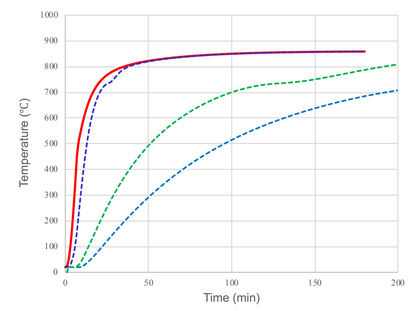
COST ESTIMATING

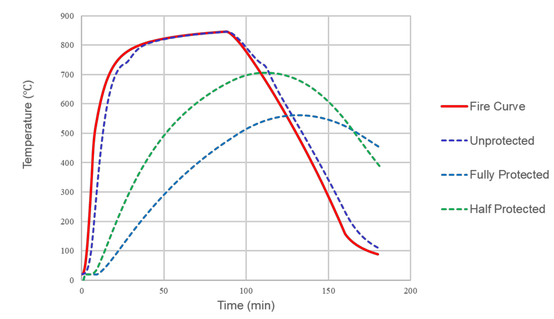
Passive Protection, Primary Framing:	$105,200
Passive Protection, Secondary Framing:	$67,800
Active Protection (Sprinklers, Alarms, etc.):	$154,600
Overall Fire Protection:	***$327,600***

FILLER BEAM ANALYSIS

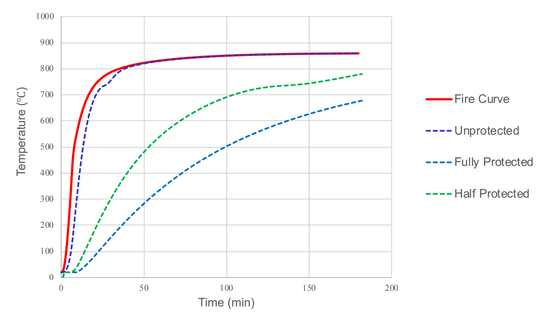
Fire with No Sprinklers *Fire with Sprinklers*

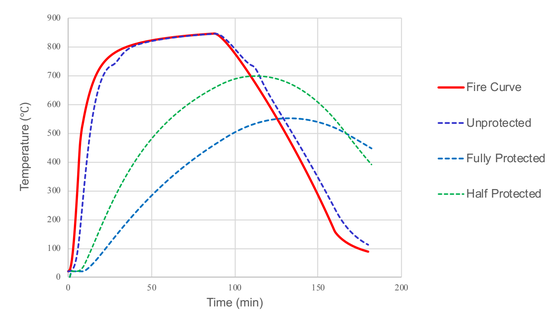
W14x22



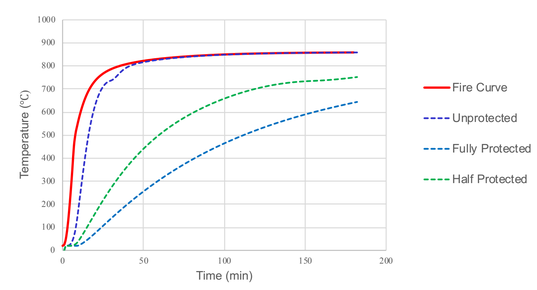


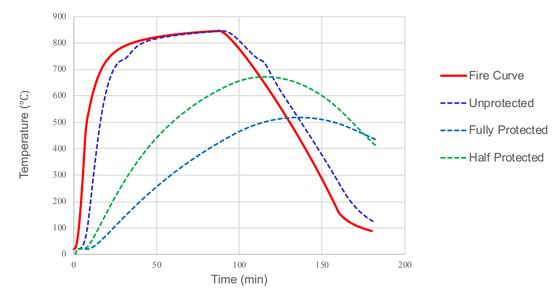
W16x26





W18x35





CONCLUSIONS

Considering the construction implications and the influence of passive (insulation) vs. active (sprinklers) protection, it may be possible to reduce the amount of fire protection on secondary framing members and still maintain an acceptable level of life safety (i.e. with conservative time of egress) during a fire event.

FUTURE WORK

- ❑ Evaluate the influence of the slab-beam composite interaction on the fire resistance of secondary filler beams.
- ❑ Determine damage thresholds that correspond to engineered levels of fire protection.
- ❑ Use cost and labor estimates as variables in fire protection selection based on engineered performance.

REFERENCES

- ❑ AISC Design Guide 19: Fire Resistance
- ❑ 2018 International Building Code
- ❑ ASCE Standard 29-05
- ❑ ASTM Standard E119-14
- ❑ 2017 UL Fire Resistance Directory
- ❑ Amy Kordosky, M.S. Structural Eng. Thesis, Lehigh Univ., 2017

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