Report on 'Cellulosic passive fire protection fundamentals and structural fire design'

by Ir. Chong Chee Meng

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The Civil and Structural Engineering Technical Division (CSETD) organized a webinar talk on 'Cellulosic passive fire protection fundamentals and structural fire design'. The webinar talk was held on 15th November 2021 via Go To Webinar platform. The speaker was Mr David Baron. Mr David Baron is a chartered engineer with 15 years of experience in the industry, with an emphasis on steel design for both ambient and fire limit states using various global design standards. He now leads a global team responsible for fire engineering and estimation of intumescent coatings. He is also a practicing structural fire engineer for over seven years.

This talk was moderated by Ir Ng Beng Hooi, committee member of CSETD and was attended by 119 participants. The 119 participants included engineers from engineering consultants, contracting firms, government agencies and local authorities as well as faculty members from local institutions of higher learning.

Mr David started his talk by introducing types of fire. There are 2 types of fires i.e. cellulosic fire and hydrocarbon fires. Cellulosic fires occur when burning wood, textiles and paper and normally happen at civil construction sites whereas hydrocarbon fires occur when burning oil or gas and normally happen at O&G or petrochemical industry. He clarified that the talk will focus on cellulosic fires only. Mr David proceeded to explain that temperature rise in steel needs to be limited to prevent structure losing stability in the event of a fire.

After the brief introduction on cellulosic fires and the needs for fire protection for steel structures, Mr David informed that there are 3 broad types of fire protection normally adopted for steel structure i.e. using board, using spray and using intumescent coating. The boards form a box around the metal profile, they are fixed either mechanically or by gluing. Board usually used for technical profiles of constant sections where site cleanliness is sought or for decorative purposes. Spray fire protection normally consist of cement, gypsum, vermiculite or perlite. It is cheap and effective and often hidden due to aesthetics. The thickness of spray is approximately 15mm to 50mm. Intumescent coatings are reactive coatings which expand as a result of heat exposure, forming a low thermal conductivity char. Expansion is normally around 50 times the applied dry film thickness (DFT). Intumescent coating normally 0.5mm to 10mm thick and applied using spray gun or brush. Intumescent coating can be applied on & off site and can improved aesthetic finish. It is damage resistant and fast application.

Mr David continued his presentation by sharing with the participants how to calculate the intumescent thickness. Mr David reiterated that there are 3 factors affecting the dry film thickness i.e. steel section factor, fire duration and temperature. The rate of increase in the temperature of a steel cross section is determined by the ratio of the heated surface (A) to the volume (V). This ratio, A/V has units of m^{-1} and is known as section factor. The fire resistance requirement for a building and therefore the frame is defined in terms of the fire resistance period and stated in terms of

minutes. The purpose of setting a fire resistance period is to ensure that in the event of a fire within a building, the load bearing capacity of the building will continue to function until all occupants have escaped. Critical/limiting steel temperature is the maximum temperature of a steel member prior to failure. Prescriptive limiting temperatures can be adopted to ensure robust levels of passive fire protection are applied.

At the end of the talk, there were questions raised by the audience which Mr David answered and clarified in more details.

INTUMESCENT COATINGS

Intumescent coatings are reactive coatings which expands as a result of heat exposure, forming a low thermal conductivity char. Expansion is normally around fifty times the applied DFT.

Intumescent coatings typically consist of:

- Binder system
- Catalyst
- Carbon source
- Blowing agent

Intumescent coating exposed to a fire – demonstration of thermal increase

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