Dual Hydrant Modelling

Water · https://mes100.com/docs/dual-hydrant-modelling/

Rationale of multiple hydrant modelling

Picture a fire scene where one hydrant is already in use, hose reels fully deployed, yet the fire refuses to die down. The building is larger than anticipated, the fire load is heavier, and the blaze is spreading faster than anticipated. In such emergency situations, reliance on just a single hydrant won't be enough. Firefighters must act quickly to protect lives while minimizing property damage. So, alternative strategies that they can do is by opening other pillar hydrants and operating them simultaneously.

But for civil engineers POV, what do you think will happen when multiple hydrant sources are activated at the same time? Though opening more hydrants can double or triple the water that can be drawn out, how about the pressure exerted at each hydrant source? Will there be enough to deliver a powerful water stream for effective fire suppression? Which is more effective, utilizing one, or more hydrants at one time? So these are the questions that we, as engineers, need to ponder, to ensure our water reticulation design is still functional even under the worst case scenario.

This article presents a simple hydrant modeling study using MiTS. The aim is to simulate fire hydrants within a water distribution network when one or two hydrants are activated at the same time to assess the hydraulic performance, capacity, and influence on pressure during fire events.

Fire Hydrant Requirement

In this model, the fire flow design will be following hydrant requirement outlined in main 3 guidelines/ standards, which are SPAN, MS 1489: PART 1: 1999 and UBBL:

1. **SPAN Uniform Technical Guidelines**

B.4.1 External Reticulation Networks and Supply Mains

Hydrant pipelines shall be installed separately from water pipelines within the confines of any area accommodating apartments/ condominiums, factories, office and commercial complexes, institutional buildings and schools. Separate water meters shall be provided for hydrant and domestic pipelines.

2. **MS 1489: PART 1: 1999**

SECTION TWO: PROVISION AND SITING OF HYDRANTS AND RISERS

5. Fire hydrants, external

5.1 *Where fire hydrants are to be installed, they should be included as part of ring fire main system (see clause 9.7) and be positioned not more than 30 m from an entry to any building on the site and* ***not more than 90 m apart.*** *They should preferably be sited immediately adjacent to road-ways or hard-standing facilities provided for fire brigade appliances. They should normally be not less than 6m from the building or from the risk so that they remain usable during a fire.*

3. **SELANGOR UNIFORM BUILDING BY-LAWS 1986**

PART VIII

FIRE DETECTION, FIRE ALARM AND FIRE EXTINGUISHMENT

225. Detecting, warning and extinguishing fire.

2) Every building shall be served by at least one fire hydrant located not more than 45 metres from the fire brigade access, designed and installed in accordance with MS 1489. In any case, hydrants shall be located ***not more than 90 metres apart.***

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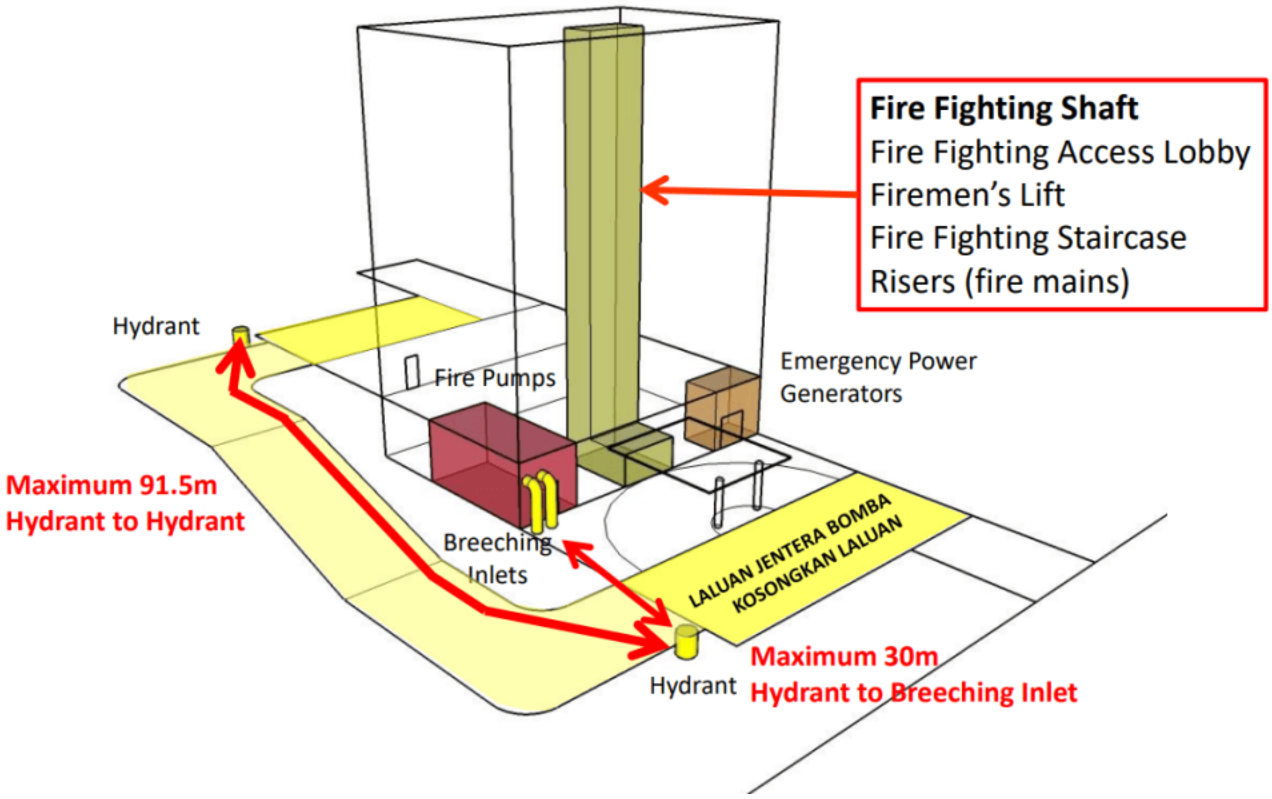


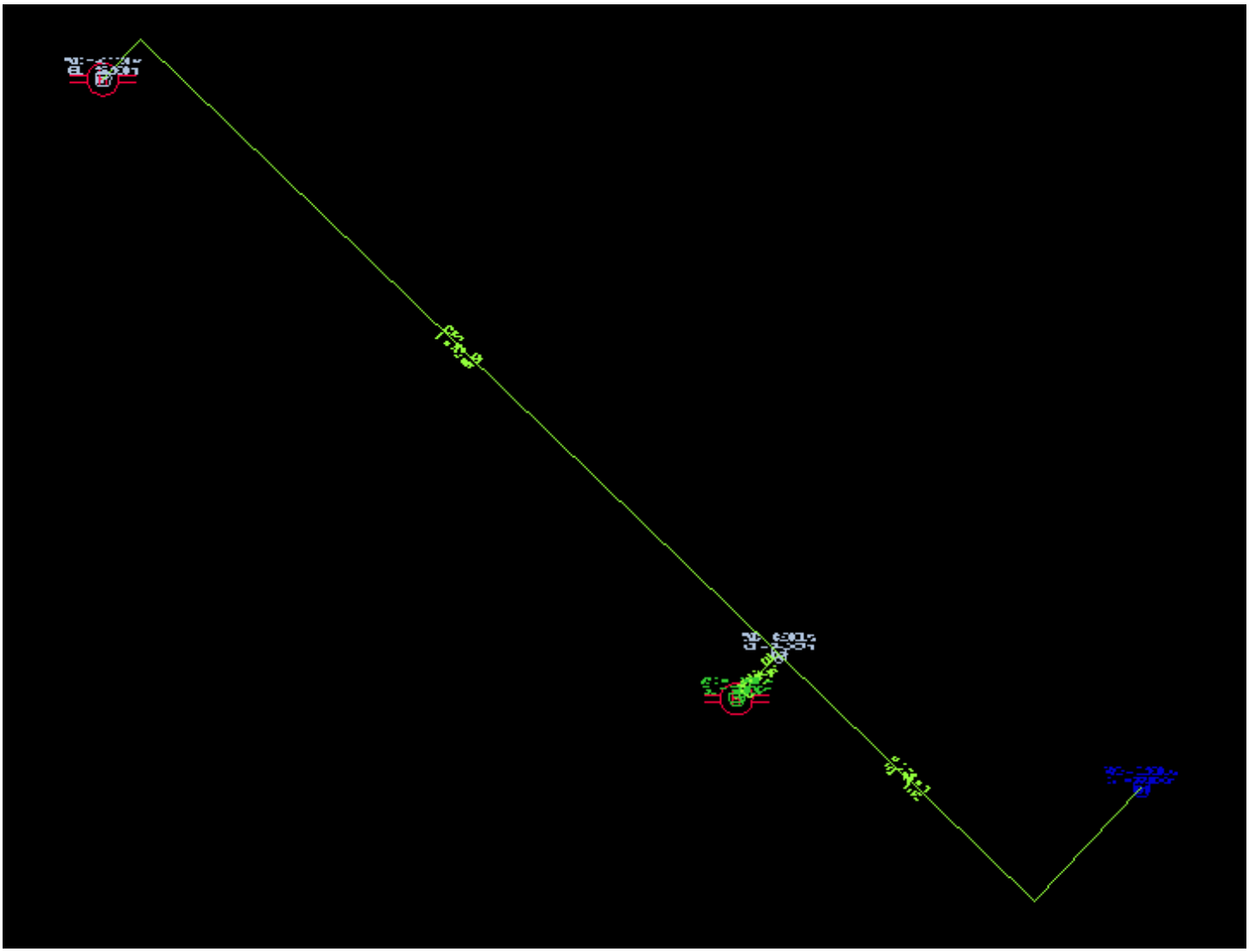
Required Hydrant to Hydrant Spacing (Picture taken from PAM Slide by Ar Chong Lee Siong)

Model Overview

3 hydrant scenarios will be modeled and studied to observe the hydraulic behaviour.

1. Dual hydrant activation
2. Single hydrant activation at nearest branch
3. Single hydrant activation at furthest branch

Project file sample



Hydrant model

Hydrant Model Information

Pressure head tapped from existing main line (Fixed head)	: 50m ODL
Ground level	: 22m
Hydrant to hydrant spacing	: 57m horizontal apart < 90m (from MS and UBBL)
Hydrant demand (at each node)	: 22.7 L/s (equivalent to 1362 L/min)

Results

1. **Residual Pressure, m (2 Hydrant VS 1 Hydrant)**

NODE	DUAL HYDRANT :D3 AND D4	SINGLE HYDRANT: D3 (NEAREST BRANCH)	SINGLE HYDRANT: D4 (FURTHEST BRANCH)	PRESSURE (2H VS
D3	25.595	27.278	27.355	1.76
D4	24.482	27.355	26.165	1.68

2. **Hydraulic Grade Line, m (2 Hydrant VS 1 Hydrant)**

NODE	DUAL HYDRANT (NODE D3 AND D4)	SINGLE HYDRANT: D3 (NEAREST BRANCH)	SINGLE HYDRANT: D4 (FURTHEST BRANCH)	HGL DR (2H VS
D3	47.595	49.278	49.355	1.76
D4	46.482	49.355	49.355	1.68

3. **Head Loss, m – Hazen William Head Loss Formula**

PIPE	DUAL HYDRANT (NODE D3 AND D4)	SINGLE HYDRANT: D3 (NEAREST BRANCH)	SINGLE HYDRANT: D4 (FURTHEST BRANCH)
DP1	2.328	0.645	0.645
DP2	0.077	0.077	0.000
DP3	1.190	0.000	1.190

Discussion/ Conclusion

1. **Dual Hydrant Vs Single Hydrant**

The results clearly show the expected hydraulic behaviour when comparing dual hydrant operation against single hydrant operation. When two hydrants (D3 and D4) are opened simultaneously, the system experiences double the total flow. Thus, more energy is lost through friction within the pipes and fittings ($Q \propto V \propto hf$). As a result, both the residual pressure and the hydraulic grade line (HGL) at the hydrant locations decrease.

Despite this drop, **the reduction in residual pressure is smal**l (Surprise Surprise!), typically around 1.7 m when compared to single hydrant operation. The residual pressures under dual hydrant conditions remain within a healthy range of 24 m to 27 m, which is well above minimum requirements according to SPAN and BOMBA guidelines. This indicates that the system is capable of supporting simultaneous hydrant use without compromising operational safety.

A similar trend is observed for the HGL, where the difference between dual and single hydrant operation mirrors the pressure drop. The HGL reduction is also minor (less than 2 m), showing that the hydraulic head available in the system remains adequate even during the more demanding dual hydrant scenario.

All in all, we can conclude that the dual hydrant scenario governs the design, as expected, and represents the worst-case hydraulic condition, since the pressure is lowest compared to when activating a single hydrant. Should the hydraulic performance be not achieved, pumps need to be incorporated in the design to elevate the pressure.

2. **Single Hydrant Location from Water Source (Near Vs Far)**

We can infer that the residual pressure drops further when the fire hydrant is positioned far from the main water source, or when located at a remote or dead-end node. This is expected, because the longer the distance from the water source (the main supply), the higher the accumulated friction loss along the pipelines, resulting in lower pressure at the furthermost hydrant.

Therefore, in a case where civil engineers want to model a single hydrant activation only, it is advised to set the hydrant node at the furthest location to assess whether the residual pressure is sufficient or not to deliver water in the event of fire breakout.

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I’m the Benevolent Dictator for Life for MiTS Software cum Editor of this website. Read more here.

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