Alur Ilmu

Dirujuk oleh

- Hutan Simpan Bangi (1906-kini)
- Tasik Ghazali

Perihal

Alur Ilmu UKM (UKM Tube - Universiti Kebangsaan Malaysia, 14 Disember 2018: "Alur Ilmu UKM").
“Alur Ilmu UKM. Merupakan sebuah aliran sungai kecil yang mengalir merentasi kampus UKM Bangi. Ia merupakan sebuah sistem saliran air bagi kampus UKM untuk mengalirkan air hujan dari kawasan sekitar lingkungan pertama kampus ke Sungai Langat. Alur Ilmu telah dibina dengan simen konkrit yang berasaskan saliran semula jadi sejak pembinaan kompleks bangunan kampus Bangi pada awal 70an. Alur Ilmu yang berukuran 1.8km panjang ini bermula dari kawasan Tasik Ghazali yang berdekatan dengan bangunan Fakulti Sains & Teknologi dan mengalir melalui bangunan2 lain seperti Fakulti Ekonomi dan Pengurusan, Perpustakaan Tun Seri Lanang, Fakulti Sains Sosial & Kemanusiaan, masjid universiti dan akhirnya diluahkan ke Sungai Langat. Alur Ilmu yang merupakan sungai yang mengalir di sepanjang kampus UKM bukan sahaja berfungsi sebagai saliran dan sumber air tetapi juga merupakan antara mercu tanda landskap utama kampus.”

Kiri: Peta aliran Sungai Alur Ilmu, dari hulunya di Tasik Ghazali hingga hilirnya di Sungai Langat: *"Sungai Alur Ilmu is a 1.8 km waterways located at the core area of Universiti Kebangsaan Malaysia, Bangi. The Alur Ilmu UKM is a large storm water channel serves to store water and flows into Langat River. Originated from a hilly, forest area in front of Nuclear Science Building and flows nearby the buildings and compounds within the core area in Universiti Kebangsaan Malaysia."* (Siti Shaveera

Shadip, 2020:

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"RIVER WITHIN CAMPUS").
Kanan: Sungai Alur Ilmu UKM @ Facebook, 18 Ogos 2014: "Ketahui Kawasan tadahan Alur Ilmu".

“Alur Ilmu extends in the middle of the main campus of Universiti Kebangsaan Malaysia (UKM), receiving water from Permenant Reserved Forest and Natural Education Forest (Hutan Simpan Kekal dan Hutan Pendidikan Alam) UKM. In 1970s, the natural stream of Alur Ilmu was modi-fied into concrete stormwater channel without changing its flow (Din et al. 2012). It serves as irrigation control for rain water, ground water and any type of fluid discharged along the campus into the Langat River, Selangor, Malaysia (Mazlin et al., 2005).” (Mohd Hafiyyan M, Lee KE, Mazlin M, Marfiah AW, Goh TL, Norbert S, Marlia MH, Azhar AH @ Asia Pacific Environmental and Occupational Health Journal (ISSN 2462 -2214), Vol 3 (1): 33 – 38, 2017:

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"Spatial Distribution of Water Quality Index in Stormwater Channel: A Case Study of Alur Ilmu, UKM Bangi Campus", hlm. 34).

“Alur Ilmu is a 1.79 km urban river long stretching across the main campus of the National University of Malaysia (UKM), Bangi, Selangor, Malaysia before flowing into the Langat River. Figure 1a is the location of National University of Malaysia (UKM), Bangi Campus, Selangor, Malaysia. Figure 1b shows the location of the revitalization of water quality study through structural approach at first 500 m of Alur Ilmu urban river upstream, UKM Bangi, Selangor, Malaysia with sampling sites and the placement of the on-site water treatment system. The first 100 m of Alur Ilmu is located at the lowest elevation point of hilly terrain and flows with normal elevated terrain, closely surrounded by impervious area from building and impervious pavement. It receives water source from the Permanent Reserved Forest and Natural Education Forest (Hutan Simpan Kekal and Hutan Pendidikan Alam) UKM, rain water and stormwater runoff. Alur Ilmu has been reinforced from a natural river into a concreted urban river in 1970s concurrent with the construction of the first batch of UKM’s faculty buildings without changing its original flow (Universiti Kebangsaan Malaysia (UKM), 1978). Alur Ilmu serves as an irrigation system to remove excess water from impervious area nearby the urban river and avoid flooding. Alur Ilmu is a model of an urban river as it receives clean forest water from the upstream and surrounded by the growth of technology, social and economic activities along the urban river which convergences into Langat River at the downstream.” (Hafiyyan Mahmud, Khai Ern Lee, Mokhtar, M., Wahid, M.A. @ APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH 16(3):2681-2699, 2018 - http://dx.doi.org/10.15666/aeer/1603_26812699:

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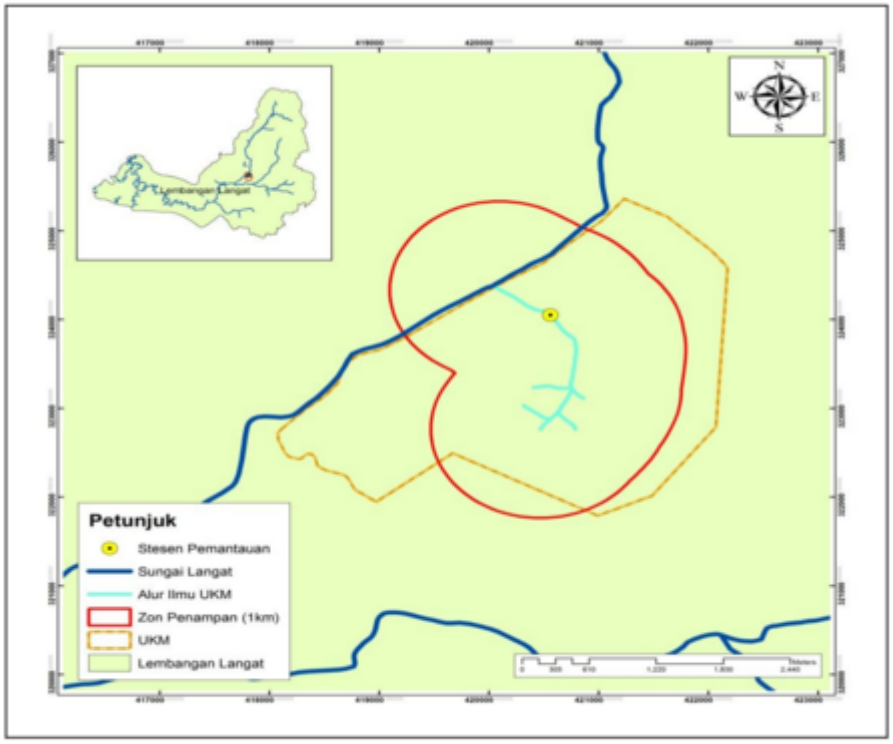
"TECHNICAL STRATEGY FOR REVITALIZING URBAN RIVER WATER QUALITY THROUGH STRUCTURAL APPROACH AT NATIONAL UNIVERSITY OF MALAYSIA (UKM) BANGI CAMPUS, SELANGOR, MALAYSIA", hlm.3).

2012-2018: Kajian Pencemaran

Hasil Kajian (2012)



Rajah 1. Lokasi Stesen Pemantauan Siri Masa Kualiti Air Alur Ilmu.

“Air yang mengalir di Alur Ilmu dibekalkan dari Hutan Simpan Kekal dan Hutan Pendidikan Alam UKM dan mengalir ke kawasan pembinaan fakulti-fakulti dan terus mengalir ke Sungai Langat, Selangor, Malaysia. Alur ini telah diubahsuai dengan simen konkrit berasaskan saliran semulajadi sejak pembinaan kompleks bangunan kampus UKM Bangi pada awal tahun 1970-an (rujuk Rajah 1). ... Alur Ilmu dibina bertujuan untuk pengawalan aliran air hujan, air bawah tanah dan apa-apa bendalir dari kampus UKM Bangi (lingkungan pertama) terus ke Sungai Langat [11]. Walau bagaimanapun, jumlah hujan yang diterima dan proses hakisan dari kawasan hulu serta kesan pembinaan bangunan baru telah melumpuhkan perangkap sedimen sedia ada lalu mengubah nilai kualiti air dan corak luahan sedia ada. Di samping itu, apabila hujan, air larian permukaan berlaku dan membawa bahan-bahan mengalir ke saluran yang tersedia dan terus ke dalam Alur Ilmu. Sisa kumbahan dan air basuhan dari kafeteria juga didapati tersalur ke alur ini tanpa rawatan sebelum di lepaskan ke Sungai Langat.” (Haslinur Md Din, Mohd Ekhwan Toriman, Mazlin Mokhtar, Rahmah Elfithri, Nor Azlina Ab.Aziz, Nur Munirah Abdullah, Mohd Khairul Amri Kamarudin, 2012:

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"KEPEKATAN BEBAN BAHAN PENCEMAR DI ALUR ILMU KAMPUS UKM BANGI: KAEDAH MIN KEPEKATAN PERISTIWA (EMC)").

Hasil Kajian (2017)

Figure 1. Alur Ilmu upstream and nearby buildings.

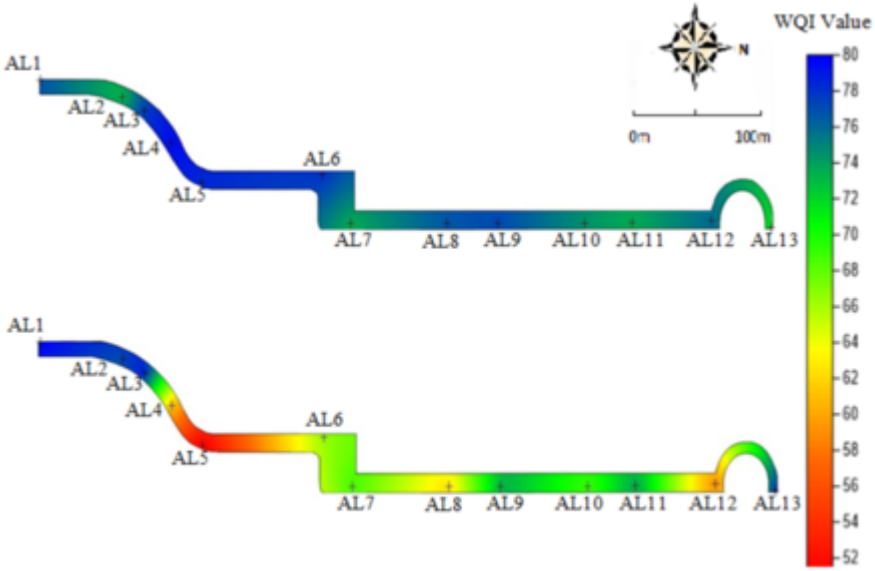

Figure 2. Kriging models of WQI during raining season (above) and dry season (below).

"Alur Ilmu stormwater channel is vulnerable to point and non-point sources of pollution because its location is close to human activities. Infrastructure developments and anthro-pogenic activities along the stormwater channel may cause serious environmental problems to Alur Ilmu. … Water quality studies on Alur Ilmu were conducted since 1999. The reported WQI of Alur Ilmu has decreased with time from Class II (Chong, 1999) to Class III and has reached Class IV in March 2012 (Din et al., 2012). Alur Ilmu is susceptible to water pollutants from nearby natural phenomenon and human activities, i.e infrastructure developments and anthropogenic activities. Existing sedi-ment trap were built at Ghazali Lake at the Alur Ilmu up-stream has reached beyond its capacity due to downpour and erosion caused by the previous building construction thus sediment accumulated and overflowed the trap during heavy rain. This has changed Alur Ilmu water quality and existing discharge pattern (Din et al. 2012). Moreover, surface runoff brings pollutants during rain and discharges from nearby pavements, buildings and cafeterias, contributing to water quality deterioration. … Din et al. (2012) found that high rainfall intensity causes high water velocity and high discharge volume decreases pollution loading in Alur Ilmu at a certain time. This study shows that high rainfall intensity is able to dilute pollutants in Alur Ilmu."

"During dry season, Alur Ilmu receives clean water, which can be seen at AL1 (Ghazali Lake), AL2 (Main Inlet) and AL3 (Inlet 1). But as moving to downstream, the water quality in Alur Ilmu is

degraded. AL4 (Inlet 2), AL5 (FST Café), AL12 (EcoNiaga), AL8 (Car Park) are detected as pollution sources during dry season. Minimum rainfall in-tensity during dry season creates stagnant water or even backwater to which no transporting energy to flow sediments and other pollutants downhill but accumulating most pollu-tion in Alur Ilmu at the point source. AL5 (FST Café) and AL12 (EcoNiaga) are the major pollution sources to the Alur Ilmu. Poor maintenance of water and oil pipes of the cafes has caused leakage which allows pollutants such as oil and grease as well as nutrients entering Alur Ilmu. It is in an agreement with the study conducted in 2015 (Afina et al., 2015) showing that EcoNiaga is the main point source pol-lution that contributes to high concentration of BOD, COD, TSS, turbidity and oil and grease in Alur Ilmu."

(Sumber: Mohd Hafiyyan M, Lee KE, Mazlin M, Marfiah AW, Goh TL, Norbert S, Marlia MH, Azhar AH @ Asia Pacific Environmental and Occupational Health Journal (ISSN 2462 -2214), Vol 3 (1): 33 – 38, 2017:

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"Spatial Distribution of Water Quality Index in Stormwater Channel: A Case Study of Alur Ilmu, UKM Bangi Campus", hlm. 34-37).

2016-01: Rawatan Air

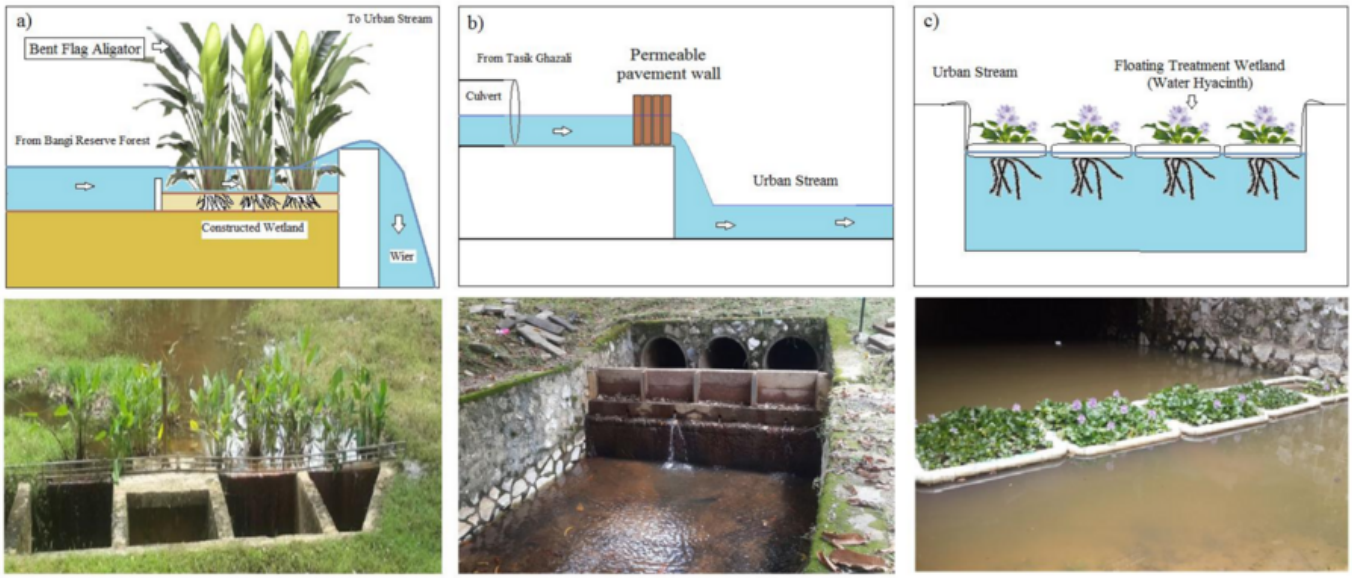

Figure 4. *Schematic diagram of the on-site water treatment systems: CONSTRUCTED wetland (a), permeable pavement wall (b) and floating treatment wetland (c)*

"The selection of on-site water treatment system undergoes screening of two general aspects which are treatment infrastructure and placement of treatment system. Both of the aspects should be complemented with the information gathered from site profiling and water quality assessment. Four components were considered in the treatment infrastructure, namely removal efficiency, design criteria, water treatment specification as well as operational and maintenance. Removal efficiency is the ability of water treatment to address targeted water quality parameters in the water body. Design criteria are the installation and development of the water treatment for on-site operation including the size and mechanism involved. Water treatment specification is the requirement for optimal efficiency and better performance and water treatment management suitability (Lim and Lu, 2016; Thomas and Reese, 2003; Din et al., 2012; Murphy et al., 2010). For the placement of the treatment system, two components are deliberated namely space limitation and strategic target close to the source of pollution.

From the aforementioned criteria, the selected on-site water treatment systems were constructed wetland, permeable pavement wall and floating treatment wetland. Figure 4 depicts the selected on-site water treatment systems used to revitalize Alur Ilmu water quality. All of the water treatment systems were fully deployed to Alur Ilmu on January 2016. The three water treatment systems were opted to complement Alur Ilmu's site profile through which Alur Ilmu is located close to human development and economic activities, i.e. faculty infrastructures, cafe and tarred road, hence the water quality is susceptible to water pollution. Surrounded by impervious hilly terrain, the concreted urban river received large surface runoff during rain. The constructed wetland was placed at the upstream of Alur Ilmu as it is effective to sink suspended solids using Bent Flag Alligator (Thalia geniculate). Permeable pavement wall and floating treatment wetland were selected because of flexible design criteria which can be retrofitted into the minimum available space of Alur Ilmu and effective on domestic water pollution and surface runoff. Four free-floating plants were studied to remove NH3-N, TSS, and BOD concentration in the water sample."

2019: Kajian Kualiti Air

"Keseluruhan panjang sungai ini adalah sekitar 1.79km bermula dengan stesen persampelan pertama iaitu di Tasik Ghazali dan berakhir di Masjid UKM. Masalah kualiti air yang kian meruncing dari semasa ke semasa telah menyebabkan keadaan fizikal Alur Ilmu dilihat semakin tercemar dan tidak menyenangkan. Justeru, satu kajian kualiti air yang terkini telah dilakukan bermula pada Jun 2019 sehingga Ogos 2019 dengan menggunakan kaedah ex-situ dan in-situ di kawasan kajian. Parameter kajian yang terlibat adalah seperti Oksigen Terlarut (DO), Permintaan Oksigen Kimia (COD), Jumlah Pepejal Terampai (TSS), Pemintaan Oksigen Biokimia (BOD), pH dan Ammonia Nitrogen (NH3-N). Sebanyak empat kali data diambil untuk mewakili kajian semasa cuaca kering dan sebanyak lima kali semasa cuaca basah atau selepas hujan. Indeks Kualiti Air (IKA) oleh Jabatan Alam Sekitar (JAS) Malaysia telah digunakan untuk mengukur tahap pencemaran dan kesesuaian jenis guna air seperti yang disarankan oleh Piawaian Kualiti Air Kebangsaan (NWQS). Seterusnya, keseluruhan hasil kajian dibandingkan untuk membezakan keadaan kualiti air semasa cuaca kering dan cuaca basah. Penggunaan aplikasi ArcGIS turut digunakan dalam konteks spatial khususnya untuk mewakili hasil data IKA di setiap stesen persampelan yang telah ditetapkan. Dapatan kajian mendapati, keadaan stesen persampelan di bahagian hulu dan tengah Alur Ilmu mencatatkan kelas IKA yang tercemar berbanding di kawasaan hilir. Kemerosotan kualiti air di stesen persampelan hulu dan tengah Alur Ilmu adalah disebabkan oleh keterdedahan kawasan stesen persampelan dengan kafeteria dan fakulti. Kerjasama daripada pelbagai pihak khususnya segenap lapisan warga UKM amat diperlukan bagi menjamin kelestarian kualiti air di Alur Ilmu ini dapat dijaga dan dipelihara." (Anne Sakina Iman Syaiffudin, Mohd Ekhwan Toriman. Geografia; Bangi Vol.16, Iss. 1 (2020):

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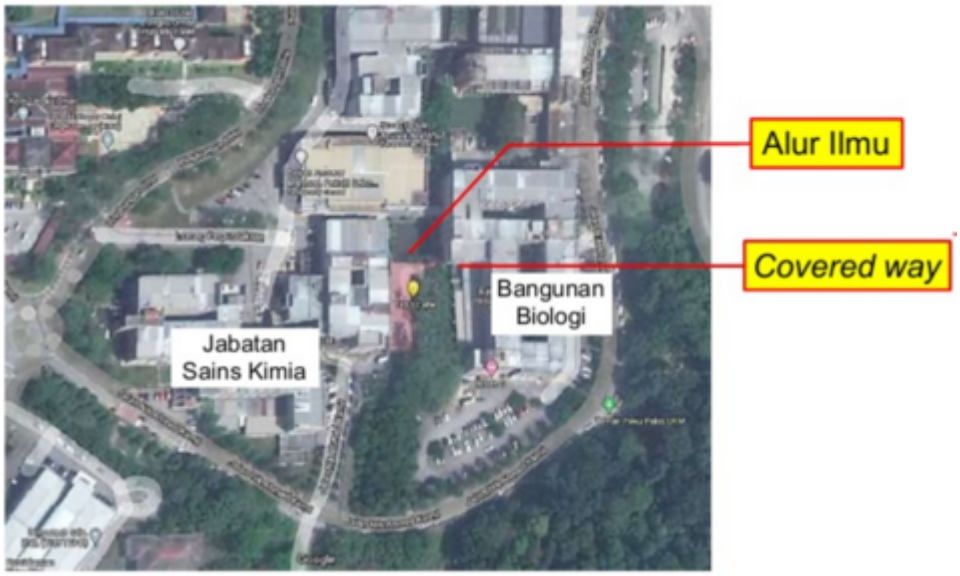
"Penilaian indeks kualiti air Alur Ilmu UKM, sub-lembangan Sungai Langat").

2021: Kesan Terhadap Bangunan

Laporan forensik JKR pada Ogos 2021 mengenalpasti antara faktor utama masalah kulat yang dikesan pada beberapa bangunan di UKM ialah aliran Alur Ilmu di situ.



RAJAH	LOKASI / ARAS	KOMPONEN	KECACATAN / KEROSAKAN	KETERANGAN
Kiri	Koridor (032), Pejabat Pengurusan Paku Pakis (034) dan *Covered Way* / Tingkat bawah	Dinding dan siling	Kulat hijau dikesan pada sebahagian besar dinding koridor. Bingkai siling mempunyai kesan berkemungkinan hasil daripada tindak balas kimia. Pemilihan bahan untuk kemasan siling tidak bersesuaian dan perlu ditukarganti dan diperincikan semula mengikut standard dan spesifikasi yang tepat.	Kulat mungkin merebak disebabkan oleh kelembapan persekitaran yang tinggi kerana berhampiran laluan aliran air (Alur Ilmu) yang melalui bangunan. Pengudaraan yang kurang baik mungkin penyumbang kepada masalah kulat.

RAJAH	LOKASI / ARAS	KOMPONEN	KECACATAN / KEROSAKAN	KETERANGAN
Kanan	Aras Bawah dan *"tunnel"*	Dinding, siling dan lantai	Kulat kelembapan	Hampir keseluruhan kawasan (dinding, siling dan lantai) di kawasan "tunnel" dan ruang berhampirannya berkulat teruk. *"Tunnel"* sentiasa menakung air kotor daripada pelbagai sumber seperti banjir, kebocoran paip dan sebagainya. Melalui temubual, wakil UKM memaklumkan bahawa, sistem saliran air sedia ada masuk ke dalam bangunan, manakala pam yang ada tidak berfungsi. Paras air yang bertakung dalam bangunan mencecah sehingga ke paras lutut. Selain itu, air juga masuk dari pelbagai sumber seperti hujan, *"tunnel"*, tasik dan lain-lain. Apabila aliran alur air yang dikenali sebagai *"alur ilmu"* (tasik berhampiran bangunan kimia) melimpah, airnya dikatakan pernah memasuki ke ruang bawah bangunan. Air juga keluar daripada tepi (kiri kanan tanah). Kulat yang terjadi di kawasan *"tunnel"* mungkin merupakan salah satu punca utama bermulanya perebakan kulat di bangunan ini.

(Sumber: Unit Forensik Senibina, Bahagian Kepakaran Pembangunan Lestari, Cawangan Arkitek, Ibu Pejabat JKR Malaysia, Ogos 2021:

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"LAPORAN PEMERIKSAAN FORENSIK SENIBINA BAGI BANGUNAN UNIVERSITI KEBANGSAAN MALAYSIA< KAMPUS BANGI PADA 19 APRIL 2021 (SKOP SENIBINA)", hlm.12,29).