

REINFORCEMENT MECHANISMS OF ROCK BOLT: A LABORATORY INVESTIGATION

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Abstract: The use of rock bolts as rock reinforcement is becoming more popular in Malaysia. However, its effectiveness depends on a number of factors particularly with regards to the technique of installing the bolt. Its reinforcement mechanism also restricts its application for certain modes of instability and types of rock. This paper highlights a laboratory investigation on the reinforcement mechanisms of rock bolts, specifically on bolt inclination, anchorage type and level of pre-tension. The investigation was conducted using a physical model of a rock bolt intersecting a joint plane. Results obtained show that a better reinforcement can be obtained if bolt is inclined at an angle to the joint plane so that it elongates upon joint displacement. Full-bonded bolt is more superior in terms of mobilising the anchorage capacity and consequently, this allows for immediate utilisation of the reinforcing element. Pre-tensioning of bolt induces clamping effect on joint surface consequently, helps to reduce joint dilatation and increases the inherent shear strength of the joint.

Keywords: *Rock bolt; bolt inclination; bonded-length; tension level.*

Abstrak: Penggunaan bolt batuan sebagai kaedah pengukuhan batuan semakin popular di Malaysia. Walau bagaimana pun, keberkesanan kaedah ini dipengaruhi oleh beberapa faktor terutamanya yang berkaitan dengan teknik pemasangan bolt. Mekanisme pengukuhan kaedah ini juga menyebabkan penggunaannya terhadap pada jenis batuan dan ragam kegagalan tertentu. Kertas kerja ini membincangkan satu kajian makmal ke atas mekanisme pengukuhan bolt batuan khususnya, mengenai kesan orientasi bolt, jenis ikatan dan tahap pra-tegangan. Kajian dilaksanakan menggunakan satu model fizikal bolt batuan yang bersilang dengan satah kekar. Keputusan kajian menunjukkan tahap keupayaan pengukuhan meningkat apabila bolt dipasang secara condong terhadap satah kekar bagi membolehkan ia mengalami pemanjangan apabila berlaku anjakan pada kekar. Bolt yang diturap sepenuhnya lebih baik dari segi menggerakkan keupayaan pengukuhan dan oleh yang demikian, kesan elemen pengukuhan dapat dimanfaatkan dengan serta merta. Pra-tegangan pada bolt dapat mengaruhkan kesan pengapitan pada permukaan kekar dan ini dapat mengurangkan dilatasi serta meningkatkan kekuatan ricih kekar.

Katakunci: *Rock bolt; orientasi bolt; panjang ikatan; tahap tegangan.*

LIME STABILIZED MALAYSIAN COHESIVE SOILS

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Abstract: This paper highlights the essential tests for assessing the suitability of lime for stabilizing soils and typical changes in soil characteristics due to modification and stabilization processes with respect to mineralogical influences. The reasoning behind the mechanism of lime clay reaction on the compressive strength development of stabilized soils has been established. Clay with acidic origin exhibit less significant increase in compressive strength compared to clay with high intensity of kaolinite and with alkaline origin. In general, lime contents instituted, ranging from 3% to 6%, have contributed to a significant increase in unconfined compressive strength, from 2.5 to 11 times of the untreated soils. The formation of calcium aluminates silicate hydrate (CASH) observed from XRD test, after 14 days, indicates the early formation of new product, due to lime-soil reaction. The effectiveness of stabilization process has been found to be dependent on the quality of the lime, clay fraction, mineralogy and the alkalinity of the soil.

Keywords: *Lime; Stabilization; Modification; Cementation; Mineralogy*

Abstrak: Kertas kerja ini menumpukan kepada beberapa ujian utama bagi menilai kesesuaian bahan kapur untuk menstabilkan tanah dan melihat kepada perubahan dalam ciri-ciri tanah terstabil hasil daripada proses pengubahsuaian dan penstabilan dengan pengaruh minerologi. Punca disebalik mekanisma tindakbalas antara kapur dan tanah liat ke atas perkembangan dalam kekuatan mampatan tanah terstabil telah dikenalpasti. Tanah liat yang berasal dari keadaan berasid kurang menunjukkan peningkatan dalam kekuatan mampatan berbanding dengan tanah liat yang mempunyai intensiti kaolinit yang tinggi dan berkeadaan alkali. Secara amnya julat kandungan kapur yang digunakan adalah antara 3% ke 6%, telah menunjukkan pertambahan kekuatan mampatan tak terkurung dari 2.5 ke 11 kali ganda berbanding tanah tak terstabil. Pembentukan kalsium aluminat silikat terhidrat (cash) daripada ujian xrd, selepas 14 hari, menunjukkan tanda pembentukan awal bahan baru dalam tindakbalas tanah dan kapur. Keberkesanan proses penstabilan kapur didapati bergantung kepada kualiti kapur, kandungan tanah liat, minerologi dan alkaliniti tanah.

KATAKUNCI: *Kapur; Penstabilan; Pengubahsuaian; Pengikatan; Minerologi.*

INTEGRATION OF SAFETY, HEALTH, ENVIRONMENT AND QUALITY (SHEQ) MANAGEMENT SYSTEM IN CONSTRUCTION: A REVIEW

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Abstract: There are several standard of management systems such as ISO 9001 for Quality Management System, ISO 14001 for Environmental Management System, and OHSAS 18001 for Safety and Health Management System. These management systems are often treated as independent functions within organizations. However, many professionals believe that it is possible to harmonise ISO 9001 QMS, ISO 14001 EMS and OHSAS 18001 OHSMS. The objectives of this study are to review the existing management standards on health and safety, environmental and quality; to study the correspondences data between these three management systems; to develop guidelines of SHEQ Integrated Management System; and to study the advantages and disadvantages of the proposed guidelines. The corresponding elements between those three management systems seem to be compatible and the possibility of integrating them is feasible. Finally, the proposed integrated Safety, Health, Environmental and Quality (SHEQ) Management System's guidelines have been developed.

Keywords: *Quality Management System; Environmental Management System; Occupational Safety and Health Management System; Integrated Management System.*

Abstrak: Terdapat beberapa standard sistem pengurusan seperti ISO 9001 untuk Sistem Pengurusan Kualiti, ISO 14001 untuk Sistem Pengurusan Alam Sekitar dan OHSAS 18001 untuk Sistem Pengurusan Keselamatan dan Kesihatan. Malangnya, sistem pengurusan tersebut sering dianggap mempunyai fungsi yang berasingan dalam organisasi. Walau bagaimanapun, ramai profesional percaya akhirnya ISO 9001 QMS, ISO 14001 EMS dan OHSAS 18001 OHSMS patut diharmonikan dalam sesuatu kaedah. Objektif kajian ini adalah untuk mengkaji standard-standard pengurusan yang sedia ada, iaitu kesihatan dan keselamatan, alam sekitar dan kualiti; mengkaji persamaan antara ketiga-tiga standard ini; menghasilkan satu garis panduan bagi Sistem Pengurusan integrasi SHEQ; dan akhir sekali untuk mengkaji kelebihan dan kelemahan garis panduan sistem yang dihasilkan. Didapati wujud persamaan yang ketara antara tiga sistem pengurusan tersebut dan kemungkinan mengintegrasikan mereka adalah tinggi. Akhirnya, satu garis panduan Sistem Integrasi Pengurusan Keselamatan, kesihatan, Alam Sekitar dan Kualiti telah dibangunkan.

Katakunci: *Sistem Pengurusan Kualiti; Sistem Pengurusan Alam Sekitar; Sistem Pengurusan Keselamatan dan Kesihatan; Sistem Pengurusan Integrasi.*

FACTORS AFFECTING ULTIMATE STRENGTH OF SOLID AND GLULAM TIMBER BEAMS

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Abstract: Phenol Resorcinol Formaldehyde is an adhesive commonly used in the fabrication of glued laminated (glulam) timber beams. Although, it has been widely accepted for softwood species, the verification of this type of adhesive for local timbers is not fully established. Four glulam beams and four solid beams were tested in bending in the laboratory. Phenol Resorcinol Formaldehyde was used as an adhesive for glulam beams. The strength of the glulam beam structure was equivalent to solid beam structure. Phenol Resorcinol Formaldehyde was able to provide sufficient bonding and strength for local timbers. The results indicated that the most significant factor influencing the strength of solid beam and glulam beam structure was the density of timber.

Keywords: *Glulam; Strength; Beam; Shorea acuminata; Phenol Resorcinol Formaldehyde.*

Abstrak: Fenol Resorsinol Formaldehid adalah perekat yang selalu digunakan untuk membuat rasuk kayu lapis berperekat (glulam). Sungguhpun perekat ini telah diguna untuk spesies kayu lembut, kesesuaiannya terhadap kayu tempatan masih belum dikaji. Empat rasuk glulam dan empat rasuk padu diuji secara lenturan di makmal. Fenol Resorsinol Formaldehid digunakan sebagai perekat rasuk glulam. Kekuatan struktur rasuk glulam ditemui setara dengan kekuatan struktur rasuk padu. Fenol Resorsinol Formaldehid ditemui boleh menghasilkan ikatan dan kekuatan yang baik ke atas kayu tempatan. Kajian menunjukkan faktor utama yang mempengaruhi kekuatan struktur rasuk padu dan rasuk glulam ialah ketumpatan kayu.

Katakunci: *Glulam; Kekuatan; Rasuk; Shorea acuminata; Fenol Resorsinol Formaldehid.*

1. Introduction

The emergence of glued-laminated (glulam) material in timber structure has given a significant impact to the timber construction industry. Glulam has a high strength to weight ratio. It can virtually be sized at any curved or straight shapes, spanned at a much higher length, designed at various strength requirements while maintaining the natural aesthetic appearance and reducing the timber waste. This

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ENTRY AND CIRCULATING FLOW RELATIONSHIP AT A ROUNDABOUT

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Abstract: This study examined the two formulas stated in the Arahan Teknik (J) 11/87 of the Malaysian Public Work Department to estimate the capacity of small and conventional roundabouts. Field survey, which cover the roundabout inventories, and vehicle classification were carried out. Vehicle classification survey indicates lower entry flows at the single lane entries compared to the multilane entries for both morning and evening peak hours. Statistical analysis was used to identify the correlation between the circulating flows, entry flows and the entry width. Results showed that the capacity obtained from the weaving concept was generally higher than the regression equations for the single and multi entries. The difference between these results may be due to the regression equations that consider the interaction between the entry and circulating flow and the geometric parameters, while the Arahan Teknik (J) 11/87 only address the geometric parameter. The entry flows for both single and multilane entries were highly dependent on the circulating flows.

Keywords: *Roundabout; Weaving Concept; Circulating Flow; Entry Flow.*

Abstrak: Kajian ini menilai dua rumus dalam Arahan Teknik (J) 11/87 oleh Jabatan Kerja Raya Malaysia, bagi menganggarkan muatan bulatan kecil dan konvensional. Pemerhatian di lapangan termasuk inventori bulatan, dan klasifikasi kenderaan telah dijalankan ke atas beberapa bulatan. Kajian klasifikasi kenderaan menunjukkan paras aliran masuk yang rendah di jalan masuk tunggal berbanding jalan masuk berbilang semasa aliran puncak pagi dan petang. Analisa statistik digunakan bagi mengenal pasti hubungan di antara aliran mengeliling, aliran masuk dan lebar masuk. Keputusan menunjukkan kapasiti yang diperolehi dari konsep menjalin keseluruhan adalah lebih tinggi dari persamaan regresi untuk jalan masuk tunggal dan berbilang. Perbezaan ini mungkin disebabkan oleh persamaan regresi mengambil kira interaksi di antara aliran masuk dan mengeliling serta geometri bulatan, manakala Arahan Teknik (J) 11/87 hanya mengambil kira parameter geometri. Bagi kedua-dua jalan masuk tunggal dan berbilang, aliran masuk sangat bergantung kepada aliran mengeliling.

Katakunci: *Bulatan; Konsep Jalin; Aliran mengeliling; Aliran Masuk.*

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