



كتاب تجارب معمل هندسة الري و الهيدروليكا



٢٠٢٣-٢٠٢٢

كتاب تجارب معمل

الري والهيدروليكا



أولاً: بيانات المعمل الأساسية

إسم المعمل: معمل الري والهيدروليكا

القسم العلمي: هندسة الري والهيدروليكا (الهندسة المدنية)

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مهندس المعمل: أعضاء الهيئة المعاونه بقسم الري و الهيدروليكا

أمين المعمل: أ/ ميادة محمد

التليفون: ١٣١١ (داخلي)

الموقع بالنسبة للكلية: مبني المعامل البحرية - الدور الأرضي والدور الأول علوي

مساحة المعمل: ٣١٦,٩ م^٢ الدور الأرضي - ٣١٦,٩ م^٢ الدور الأول علوي

ثانياً: رؤية و رسالة المعمل

رؤية المعمل

مواكبة الأسس الحديثة فى مجال تصميم و تنفيذ المنشآت المائية و البحرية و السعى نحو تحسين إدارة الموارد المائية بتوفير بيئة متميزة للتعليم و التعلم و البحث العلمي و خدمة المجتمع.

رسالة المعمل

يهدف معمل هندسة الري و الهيدروليكا لتقديم خريجين قادرين على تصميم و تنفيذ و إدارة و تشغيل المنشآت المائية و البحرية باستخدام الأساليب المتقدمة و باستخدام النظريات الهيدروليكية، للتحكم فى توزيع المياه المستخدمة فى الري و الشرب ، و كذلك للحماية من أخطار الفيضانات و الأمواج و عمل الدراسات الهيدرولوجية و إدارة المياه الجوفية و تحقيق خدمات مجتمعية تفيد المجتمع و البيئة من خلال الإختبارات المعملية و الحقلية و البحوث التطبيقية.

ثالثاً: أنشطة المعمل

خدمات طلابية

- ❖ يتيح المعمل للطلاب بإجراء التجارب المعملية لتحقيق الجانب العملي للمقررات الدراسية و فهم مبادئ علم هيدروليكا الموائع و شبكات المياه وهيدروليكا القنوات المفتوحة وهندسة الموانى.
- ❖ يشارك المعمل فى تنفيذ مشاريع تخرج طلاب الفرقة النهائية.
- ❖ يشارك المعمل فى التدريب الصيفي الداخلي لطلاب الفرقة الأولى فى برنامج الهندسة المدنية و برنامج هندسة البناء و التشييد.

خدمات بحثية

- ❖ يتيح المعمل للباحثين من طلاب الدراسات العليا و أعضاء هيئة التدريس إجراء التجارب البحثية (المعملية و الحقلية) الخاصة بالرسائل العلمية و المشاريع البحثية و المساهمة فى تطوير أساليب حماية للمنشآت الهيدروليكية و دراسة البدائل المختلفة لحواجز الأمواج و عمل الدراسات الهيدرولوجية لإدارة مصادر المياه السطحية و الجوفية.
- ❖ يتيح العمل للباحثين باستخدام برامج المحاكاه العددية بمعمل المحاكاة والنماذج العددية المرفق بالمعمل.

رابعاً: المقررات الدراسية التي يخدمها المعمل

- الفرقة الأولى مدني: مقرر هيدروليكا (١) IRH١٢١-Hydraulics-١
- الفرقة الثالثة مدني: مقرر هيدروليكا (٢) IRH٣٢١-Hydraulics ٢
- الفرقة الرابعة مدني: هندسة المواني IRH٤٣١-Harbors Engineering
- الفرقة الرابعة مدني: مشروع التخرج IRH٤٧٨-Graduation project



خامساً: قائمة بالأجهزة والمعدات الموجودة بالمعمل:

م	اسم الجهاز	المواصفات والملحقات	مسلسل	عدد
	١- أجهزة التجارب العملية			
١-١	جهاز المجرى المائي الأوتوماتيكي	طول ٥ متر، عمق ١٥ سم، ارتفاع ٧,٥٠ سم بموتور وظلمية وعدد ٢ ورنية لقياس العمق وساعة إيقاف (مستعمل)	H756467	١
٢-١	جهاز قياس ضغط النافورة	ذات قطر ١٠ مم		١
٣-١	جهاز مسار إنسياب الرمل	(مستعمل)	H657267	١
٤-١	قياس مركز الضغط	به عدد (٩) صنجة نحاس (مستعمل)	H709367	١
٥-١	جهاز قياس التصريف خلال فتحة مثلثة أو مستطيلة		H260467	١
٦-١	جهاز ثبات الجسم العائم		H332666	١
٧-١	جهاز معايير الضغط - الجهاز بوردن	به عدد (١٠) صنجة مختلفة (مستعمل)		١
٨-١	جهاز التصريف خلال فتحة	(مستعمل)	H762467	١
٩-١	جهاز التصريف خلال فتحة الفنشوري	(مستعمل)	H757467	١
١٠-١	جهاز دراسة الاحتكاك داخل أنبوبة	(مستعمل)	H249566	١
١١-١	تراييزة هيدروليكية كاملة	بمقياس بوردون للضغط ومعة ... مضخة وموتور ٢٤٠/٢٥٠ فولت،	H650367, H648267, H651367, H653367	٤
١٢-١	التربينة المحورية Flow Pump Axial Turbine	(مستعمل)	H26	١
١٣-١	خزان وعمود لجهاز دراسة الاحتكاك			١
١٤-١	ايجاد معامل السحب للأشكال Flow Apparatus Visualisation	(مستعمل)	H14	١
١٥-١	Digital Strain Bridge قنطرة الانفعال الرقمية		E31	١
١٦-١	جهاز يسمى الدائرة الهيدروليكية لقياس الأنابيب الدوارة			١
١٧-١	مضخة نافورية بصمام ضغط خلف الكابل	(مستعمل)		١
١٨-١	جهاز قياس الرطوبة مع ضغط كهربائي منخفض Tensiometer	(مستعمل)		١
١٩-١	مضخة طاردة مركزية ذات مرحلتين	عدد ٢ موتور ٣٨٠ فولت لكل موتور عداد خاص وميزان زنبركي و ٢ مفتاح تشغيل و ٤ مقياس ضغط وطقم مفتاح بلدي ٦ قطع	٣٤٧٣١٧١, ٣٥٢٦٨٧١	١
٢٠-١	مجري الفيضان المائي	بقرص زجاج كامل بالماتور ٢٤٠/٢٢٠ فولت واحد حصان ومعه حامل جهاز قياس العمق مدرج بالورنية وعداد قياس التصريف	٣٣٨/٦٦	١
٢١-١	نموذج قنطرة حجم المياه ١٠٨*٧٨*٢١ سم من الخشب السويد بدون دهان			١

١		تشمل تربيئة وخزان ودينامتر ٢ سرعة وظلمبة رقم P135787 وموتور ٢٦٠/٢٣٥ فولت و بدء التشغيل ٢٧٩٣/٢٧ - ٤٤٠/٢٠٠ فولت وحامل متحرك والماكينة كاملة ومعها غطاء من القماش السميك بلون أخضر	وحدة تربيئة (عجلة بلتون) ذاتية التشغيل	٢١-١
١		تشمل تربيئة وخزان ودينامتر ٢ سرعة وظلمبة رقم P135788 وموتور ٢٩٠/٢٣٥ فولت و بدء التشغيل ٢١٩٣/٢١ - ٤٤٠/٢٠٠ فولت وحامل متحرك والماكينة كاملة ومعها غطاء من القماش السميك بلون أخضر	وحدة تربيئة (فرانسييس) ذاتية التشغيل	٢٢-١
١			Ground Water Flow Unit جهاز سريان المياه الجوفية	٢٣-١
١	٢١٦		قناة أرضية معملية من خشب السويد	٢٤-١
١		٢٠٠*٢١*٢٠ سم صاج أسود ، وحديد زاوية ٤٠*٤٠*٤٠ مم	قناة صاج أسود	٢٥-١
١		بطول ١٢ متر وعرض ١,٥٠ متر وارتفاع ١,٥٠ متر - القناة صاج مجلفن ١,٥٠ مم وحديد زاوية ٤٠*٤٠*٤٠ مم و ٣٠*٣٠*٣٠ مم وعدد ٢ خزان ١٠٠*١٢٠*٤٠ سم صاج مجلفن ١,٥٠ مم - صفحة (١٠٨) قديم	جهاز مجمع باسم قناة مائية معملية	٢٦-١
١		صندوق رمال صغير	جهاز مجمع، دراسة حركة المياه خلال التربة	٢٧-١
١		القناة المعملية ١٧٥*١٠٠*١٠٠ سم، بطول ١٣ متر صاج مجلفن ٢ مم وحديد زاوية ٤٠*٤٠*٥٠ مم بدهان البرايمر واللاكه (صفحة ١٥٣) قديم	جهاز قياس الامواج	٢٨-١
١		(مستعمل)	Sand Box نموذج صندوق الرمال Model	٢٩-١
١			Basic Hydraulic Bench	٣٠-١
١			Energy Loses in Pilpes	٣١-١
١			Bernoulli Experiment	٣٢-١
١			Pipes Surge Apparatus	٣٣-١

عدد	مسلسل	المواصفات والملحقات	٢- أجهزة القياس	
١	٣٨٢٠	(مستعمل)	أفوميتر ياباني	١-٢
١		(مستعمل)	بارومتر مركب وبه ترمومتر	٢-٢
١	H750467		جهاز قياس التصريف	٣-٢
١	١٦٢٤٨	به ورنية دقة ١٠/١ من المليمتر وقضيب مدبب والجهاز رقم ١٦٢٤٨ ومعه قاعدة لتثبيت الورنية	جهاز قياس العمق الميكانيكي لغاية ٦٠٠ مم	٤-٢
١	١٦٢٥٠	به ورنية دقة ١٠/١ من المليمتر وبه عدد ٢ قضيب مدبب كامل باللمبة والجهاز رقم ١٦٢٥٠ ومعه قاعدة لتثبيت الورنية	جهاز قياس العمق الكهربائي لغاية ٦٠٠ مم	٥-٢
١	١٣٠٣٥	بثقل قطر ٢٥٠ مم ومعه عدد ٢ ماسك	جهاز قياس المستوي قطر ٣٠٠ مم	٦-٢
٥			ساعة إيقاف صناعة سويسري	٧-٢
١		(مستعمل)	جهاز الأوسيليسكوب Dual Trace Oscilloscope	٨-٢
١			مانومتر إلكتروني Electronic Manometer	٩-٢
١			Pressure Transducer حساس ضغط	١٠-٢
١		ملحق قضيب و مراوح بلاستيكية وكابل وساعة إيقاف ومفكات وكتالوج	جهاز قياس سرعة السريان في الحقل	١١-٢
١		كامل بمفتاح الإيقاف لقياس ٥٠٠٠ لفة مكون من ثلاث دوائر داخل علبة (مستعمل)	عداد سرعة تاكومتر Tachometer	١٢-٢
١		كامل بالحجارة والمفتاح (مستعمل)	عداد سرعة طراز F4	١٣-٢
١		مراوح وقضيب وكابل توصيل ٤ متر وساعة إيقاف	جهاز قياس سرعة السريان Current meter	١٤-٢
١		(مستعمل)	جهاز قياس سرعة السريان-رصاصي كبير Current meter	١٥-٢
١	٢٠١٢	يقيس لعمق ١٠٠ متر صناعة ألمانيا الغربية ماركة Richter	جهاز قياس منسوب سطح المياه يعمل بالبطاريه	١٦-٢
١		١٤٥ psi	Pressure Transducer حساس ضغط	١٧-٢
١			ميكرومتر	١٨-٢
١		H12-9 Basic Portable Pressure Meter (140 mBar)	Pitot tube 450 mm - Model H30-3H جهاز قياس سرعة السريان	١٩-٢
١		Micro ADV 16 mhz, Splash-proof System	جهاز قياس السرعات على ٣ اتجاهات	٢٠-٢
			Digital Hook & Point Gauges (H1-7: 300mm)	٢١-٢
١			جهاز قياس الأمواج وحساسات الضغط	٢٢-٢
٢		Temperature Sensor (Fixed Infrared) Temperature Transducer with Configurable Via USB Connection to PC -(OS151-USB)	حساس قياس درجة الحرارة	٢٣-٢
٥		Pressure Transducer High performance, Rugged All Stainless Steel Construction (PX309-030G5V)	حساس قياس الضغط	٢٤-٢

١	Portable 4 to 8 Channel Data Logger - Omega Model No. SQ2010 + Carrying Case + 2 Cell Batteries + Input Terminal Block + Screwdriver + USB Cable + OM-SQ-Software + AC Adapter	Data Logger مسجل بيانات محمول	٢٥-٢
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عدد	مسلسل	المواصفات والملحقات	٣- أجهزة الحاسب	
١		Intel P4 -MB-GB intel 945 - ATX P4 -350 watt - Mic Keyboard - Opt. mouse - RAM 512 MB DDR11533 - FDD 3.5 -1.44 MB- S.Woofier 1000 watt - Headset - Pad - . Monitor 17 inch Flat	جهاز كمبيوتر بالمواصفات	١-٣
١		Dell Precision T7910 Workstation - Memory 128GB 2133MHz DDR4 (8x16GB RDIMM ECC - Processor: Intel® Xeon® Processor E5-2650 v3 (10C, 2.3GHz, 25M, 105W) - Video Card: NVIDIA Quadro K4200 4GB (2DP, DL-DVI-I) (1 DP to SL-DVI adapter) - Hard Drive: 3.5 inch 2TB SATA 7.2K RPM HDD - Dell U2412M Monitor, Silver, EUR * Patr Number (U2412m)	جهاز حاسب DELL Workstation آلي	٢-٣
١		* Mothrboard: Intel E5200 2.5GHz 2MB Foxconn G41 - Processor: Intel® Core i3 4th generation processor - Memory: 2GB DDR2 - Hard Drive: 320 GB WD HDD - DVD: R/W Samsung - LAN integratwd - Case: ATX - Keyboard: PS2- Opt. mouse - Monitor: LG 14 inch LCD - Sound integratwd - Card Wireless	جهاز حاسب آلي شامل الشاشة (مكتب د/زيدان) ٢٠١٠	٣-٣
١		* M920 i7	جهاز حاسب آلي لينوفو شامل الشاشة (مكتب د/زيدان)	٤-٣
٢		* Mothrboard: Intel Chipset M81 with integrated (VGA-LAN-Sound) Gigabite - Processor: Intel® Core i3 4th generation processor - Memory: 4GB DDR3 - Hard Drive: 500 GB SATA 7200 RPM HDD - DVD: R/W Samsung - VGA Card: Force Nvidia 4G - USB Keyboard - Opt. mouse - Monitor: 18.5 inch LED Samsung	جهاز حاسب آلي	٥-٣
		Canon i-SENSYS LBP6030B	طابعة ليزر كانون	٦-٣

عدد	مسلسل	المواصفات والملحقات	٤- أجهزة العرض والتصوير والاتصال
١			بروجيكتور Over Head Projector
١			شرايح بروجيكتور عرض Reflecta AF 35 mm Slide Projector
١			شاشة عرض Projection Screen
١		مرفق معها حامل ثلاثي ٢ إسطوانة تسجيل، والشنطة الخاصة بها	كاميرا رقمية SONY CD 500
١		InFocus IN124A data projector Standard throw projector 3500 ANSI lumens DLP XGA (1024x768) مرفق وحدة - ٣D compatibility Black نعليق اليقف + كابل توصيل	داتا شو
عدد	مسلسل	المواصفات والملحقات	٥- ظلمبات وأجهزة كهربية
١		طراز NTO-200 على شاسية من كمر حديد مع محرك قدرة ٤٠ حصان إيطالي ٣٨٠ فولت	ظلمبة رفع مياه ماركة كالبيدا متنتقلة
١		قدرة ١,٥ حصان - طراز DLM109	ظلمبه غاطسه
١		قدرة ١,١ ك وات عند سرعة ٢١ لفة - ثلاثي الأوجه - ٣٨٠/٢٢٠ فولت	محول كهربائي بالجير بوكس
١		حصان ٢,٥٠	جهاز تكييف
عدد	مسلسل	المواصفات والملحقات	٦- معدات وخامات
١		بلقمة صلب (مستعمل)	منجلة زهر
١		(مستعمل)	مشحمة يدوي ٢*١
١			طقم مفتاح بلدي ١٢ قطعه
١		(مستعمل)	فلانشة نحاس أصفر بها سلبه خارجية، خارجي ١٥ مم، داخلي ٥٤ مم، عرض ٦٥ مم
١		(مستعمل)	ماكينة جليخ ٦ بوصة حجرين الماني
١		(مستعمل)	زرجينة رولمان بلي ٦ بوصة ٣ رجل
٥			المونيوم زاوية - ٣ متر - ٣*٣*٣ مم
٦			كوع ٣ بوصة مستورد
١			محبس سكينه ٣ مستورد
١٨			مواسير حديد ٣ بوصة مجلفن ثقيل
١			كوع ٣ بوصة
١			قفل ٢,٥ بوصة
١٠			قرص خشب
١			اكريك شفاف ٢٠٠*٣٠سم
٢			قفل ٢,٥ بوصة

سادساً: قائمة بالتجارب التي تؤدي داخل المعمل (مرحلة البكالوريوس)

م	التجربة	الغرض منها
١	دراسة ثبات الجسم العائم (Stability of the floating body)	يستخدم الجهاز فى قياس ثبات الأجسام الطافية ودورانها واتزانها.
٢	جهاز قياس التصرف من خلال فتحة دائرية (Discharge through an Orifice)	يستخدم الجهاز لتوضيح كيفية حساب التصرف عن طريق عبور المياه خلال فتحة دائرية.
٣	السريان فوق الهدارات (Flow over weirs and notches)	يستخدم الجهاز لتوضيح كيفية حساب التصرف عن طريق عبور المياه فوق هدار مثلث الشكل
٤	الفواقد خلال خطوط المواسير والشبكات (Friction loss in pipes and networks)	يستخدم الجهاز لتحديد الفواقد الرئيسية خلال خطوط المواسير
٥	الضغط الهيدروستاتيكي علي الاسطح المغمورة (Hydrostatic pressure on submerged surfaces)	يستخدم الجهاز لتحديد الضغط الهيدروستاتيكي علي البوابات و تحديد مركز الضغط
٦	السريان خلال الفتحات (flow through orifices)	يستخدم الجهاز لتحديد معاملات السرعة والإختناق والتصريف
٧	السريان خلال الفنشوريمتر (Flow through Venturi-meter)	يستخدم الجهاز لتحديد التصريف خلال الأنابيب
٨	المطرقة المائية (water hammer)	قياس سرعة موجة الطرق
٩	القفزات الهيدروليكية (Hydraulic jumps)	تصميم الفرشة الخرسانية خلف منشآت الحجز

سابعاً: الخدمات المجتمعية التي يؤديها المعمل

جاري تطوير المعمل لكي يستطيع ان يؤدي خدمات مختلفه لقطاع الإنتاج وتنفيذ المشروعات ومنها:

- إختبارات التحميل الهيدروليكي للمواسير والمحابس والكيعان وكافة الوصلات إختبارات الضخ وخصائص ظلمبات الرفع
- تجارب السريان غير المستقر بالقنوات المفتوحة بالمواسير
- قياسات الملوحة والمعاملات التي تحدد علاقات المياه والتربة والنبات.
- قياس السرعات و حساب التصرفات فى القنوات الحقلية المبطنه و الغير مبطنه.
- عدد المستفيدين من المعمل: لا يوجد
- الجهات التي تتعاون مع المعمل: لا يوجد
- الدخل السنوي للمعمل: لا يوجد
- الجهات الممولة لأنشطة المعمل: لا يوجد
- المشاريع التنافسية التي يشارك فيها المعمل: لا يوجد

ثامناً: الخدمات الطلابية التي يؤديها المعمل

- وتشمل التجارب التي تجري في المعمل لشرح الظواهر الطبيعية والتطبيقات العملية الخاصة بمواد ميكانيكا الموائع، هيدروليكا، نظم الري والصرف، هندسة الموانئ.
- عدد الطلاب المستفيدين من المعمل: حوالي ١٠٠٠ طالب
- الأقسام العلمية المستفيدة من المعمل: الهندسة المدنية
- الفرق الدراسية المستفيدة من المعمل: الأولي مدني – الثالثة مدني – الرابع مدني
- المقررات الدراسية التي تستفيد من المعمل: هيدروليكا (١) – هيدروليكا (٢) – الموانئ والملاحة الداخليه
- الأنشطة الطلابية داخل المعمل: لا يوجد
- عدد الدورات التدريبية التي تمت في المعمل: لا يوجد
- المسابقات العملية التي شارك فيها طلاب من المستفيدين من المعمل: لا يوجد

تاسعاً: الخدمات البحثية

وتشمل الدراسات البحثية التي تجري في المعمل يقوم بها بطلبة الدراسات العليا والساده أعضاء هيئة التدريس لدراسه السريان السطحي، حركة المياه الجوفية، حركة المواد الرسوبية، وغيرها.








■ عدد طلاب الدراسات العليا المستفيدين من المعمل: ٤ طلبة



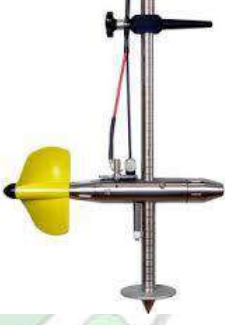

■ عدد الرسائل العلمية التي تمت في المعمل: حوالي ٢٠ رسالة



عاشراً: صور للأجهزة بالمعمل

#	Item/Instrument	Key Specs	Image
١	Full hydraulic bench with Borden pressure gauge	This is a basic unit that provides water supply and gravimetric measurement services for use in conjunction with other accessories for specific experiments	
٢	Hydraulics Bench- FME ٠٠	The Hydraulics Bench, "FME ٠٠", is formed by a movable hydraulics bench used to hold a wide variety of modules, which allow the student to experiment with the problems presented by fluid mechanics.	
٣	Photon Basic Hydraulic Bench	Photon Basic Hydraulic Bench is equipment fluid mechanics laboratory. The flow over weirs experiment is included in Basic Hydraulic Bench.	
٤	Bernoulli's principle demonstrator	Demonstration of Bernoulli's theorem, the sum of pressure energy + Kinetic energy + potential energy = constant.	
٥	Flow over weirs	Study of the flow characteristics through a weir with a rectangular weir, square, trapezoidal and circular weir	
٦	Hydrostatic pressure apparatus	Studying the center of pressures for partial immersion.	

#	Item/Instrument	Key Specs	Image
٨	Impact of jets	Determine the impact of jets against a flat surface, a curve surface of 120° and a hemispherical surface.	
٩	Metacentric Height	Study the stability of a floating body at different positions of the center of gravity.	
١٠	Surge tank and water hammer unit	Investigating the effects of pipe hammer caused by a fast closing valve, Measuring the pressure profile of hammer, and Demonstration of water level oscillations in the surge tank.	
١١	Dead Weight Pressure Gauge Calibrator	This calibrator functions on the same principle adopted in calibrating industrial pressure gauges.	
١٢	Friction loss in pipes	Flow through pipes of differing diameters under laminar and turbulent flow conditions. Investigations of the flow/pressure drop relationship for an annular pipe.	
١٣	Ground Water Flow Unit	Demonstrate ground water flow and the resulting hydraulic gradients, including the effect of permeability. Demonstrate cone of depression for a single well in an unconfined aquifer	
١٤	Vernier Hook & Point Gauges	The measurement of steady state water surface position is frequently needed during hydraulic investigations.	

#	Item/Instrument	Key Specs	Image
١٥	Free and forced vortex apparatus	Experiment to plot the shape of a free vortex by measurement of the surface profile coordinates, and thus verify that " $v r = c$ " where v is the speed and " r " is the radius of the vortex	
١٦	Flow channel with width ٧,٥ cm	<p>١. Study of uniform flow in inclined channel, verification of Chézy equation and determination of Chézy coefficient and Manning's friction factor.</p> <p>٢. Study of flow under a sluice gate (undershot weir) with application of specific energy and momentum functions.</p> <p>٣. Hydraulic jump – determination of energy head and power loss at the jump section by means of specific energy considerations.</p>	
١٧	Field Current Meter	Current Meter is designed for flow velocity measurements in combination with hand-held wading rods or cable suspended from a bridge or boat.	
١٨	Counter set of current meter flow measurements	It automatically records the number of propeller revolutions by counting the impulses. Besides, it can output the velocity of flow immediately	

#	Item/Instrument	Key Specs	Image
١٩	Acoustic Doppler Velocimeter (ADV)	The ADV is a single point, high-resolution Doppler current meter which provides 3-D velocity measurements in a remotely sampled volume.	
٢٠	Laboratory channel (Wave Flume)	Its rigid steel bed raises ١,١٦ m from the laboratory ground level. The total length of the flume consists of head tank ١,٠٠ m long, an approaching steel part ١٠,٥ m long, working section made from Perspex ٢,٦ m long, and the tail tank ١,٠٠ m long. The flume is equipped with a variable speed flap type wave generator and a porous screen filled with uniform gravel at one end of the flume.	 
٢١	Open channel laboratory flume	Large open channel flume that provides the opportunity for advanced research and student study on a wide range of fluid flow topics.	
٢٢	Open channel laboratory flume (Steel)	flume for student study and advanced research into a wide range of fluid flow topics. A huge range of ancillaries is available to extend learning potential and offers the opportunity for innovative experimentation.	



كتاب تجارب معمل

الري والهيدروليكا



أولاً: بيانات المعمل الأساسية

إسم المعمل: معمل الري والهيدروليكا

القسم العلمي: هندسة الري والهيدروليكا (الهندسة المدنية)

المشرف: د/ أحمد صدقي الحمرابي د/ محمود السيد عبد المعبود

مهندس المعمل: أعضاء الهيئة المعاونه بقسم الري و الهيدروليكا

أمين المعمل: أ/ مبيادة محمد

التليفون: 1311 (داخلي)

الموقع بالنسبة للكلية: مبني المعامل البحرية – الدور الأرضي والدور الأول علوي

مساحة المعمل: 316.9 م² الدور الأرضي - 316.9 م² الدور الأول علوي

ثانياً: رؤية و رسالة المعمل

رؤية المعمل

مواكبة الأسس الحديثة فى مجال تصميم و تنفيذ المنشآت المائية و البحرية و السعى نحو تحسين إدارة الموارد المائية بتوفير بيئة متميزة للتعليم و التعلم و البحث العلمى و خدمة المجتمع.

رسالة المعمل

يهدف معمل هندسة الري و الهيدروليكا لتقديم خريجين قادرين على تصميم و تنفيذ و إدارة و تشغيل المنشآت المائية و البحرية باستخدام الأساليب المتقدمة و باستخدام النظريات الهيدروليكية، للتحكم فى توزيع المياه المستخدمة فى الري و الشرب ، و كذلك للحماية من أخطار الفيضانات و الأمواج و عمل الدراسات الهيدرولوجية و إدارة المياه الجوفية و تحقيق خدمات مجتمعية تفيد المجتمع و البيئة من خلال الإختبارات المعملية و الحقلية و البحوث التطبيقية.

ثالثاً: أنشطة المعمل

خدمات طلابية

- ❖ يتيح المعمل للطلاب بإجراء التجارب المعملية لتحقيق الجانب العملي للمقررات الدراسية و فهم مبادئ علم هيدروليكا الموائع و شبكات المياه وهيدروليكا القنوات المفتوحة وهندسة الموانئ.
- ❖ يشارك المعمل فى تنفيذ مشاريع تخرج طلاب الفرقة النهائية.
- ❖ يشارك المعمل فى التدريب الصيفي الداخلي لطلاب الفرقة الأولى فى برنامج الهندسة المدنية و برنامج هندسة البناء و التشييد.

خدمات بحثية

- ❖ يتيح المعمل للباحثين من طلاب الدراسات العليا و أعضاء هيئة التدريس إجراء التجارب البحثية (المعملية و الحقلية) الخاصة بالرسائل العلمية و المشاريع البحثية و المساهمة فى تطوير أساليب حماية للمنشآت الهيدروليكية و دراسة البدائل المختلفة لحواجز الأمواج و عمل الدراسات الهيدرولوجية لإدارة مصادر المياه السطحية و الجوفية.
- ❖ يتيح العمل للباحثين باستخدام برامج المحاكاه العددية بمعمل المحاكاة والنماذج العددية المرفق بالمعمل.

رابعاً: المقررات الدراسية التي يخدمها المعمل

- الفرقة الأولى مدني: مقرر هيدروليكا (1) IRH121-Hydraulics-1
- الفرقة الثالثة مدني: مقرر هيدروليكا (2) IRH321-Hydraulics 2
- الفرقة الرابعة مدني: هندسة المواني IRH431-Harbors Engineering
- الفرقة الرابعة مدني: مشروع التخرج IRH478-Graduation project



خامساً: قائمة بالأجهزة والمعدات الموجودة بالمعمل:

م	اسم الجهاز	المواصفات والملحقات	مسلسل	عدد
	1- أجهزة التجارب المعملية			
1-1	جهاز المجرى المائي الأوتوماتيكي	طول 5 متر، عمق 15 سم، ارتفاع 7.50 سم بموتور وظلمبة وعدد 2 ورنية لقياس العمق وساعة إيقاف (مستعمل)	H756467	1
2-1	جهاز قياس ضغط النافورة	ذات قطر 10 مم		1
3-1	جهاز مسار إنسياب الرمل	(مستعمل)	H657267	1
4-1	قياس مركز الضغط	به عدد (9) صنجة نحاس (مستعمل)	H709367	1
5-1	جهاز قياس التصريف خلال فتحة مثلثة أو مستطيلة		H260467	1
6-1	جهاز ثبات الجسم العائم		H332666	1
7-1	جهاز معايير الضغط - الجهاز بوردن	به عدد (10) صنجة مختلفة (مستعمل)		1
8-1	جهاز التصريف خلال فتحة	(مستعمل)	H762467	1
9-1	جهاز التصريف خلال فتحة الفنثوري	(مستعمل)	H757467	1
10-1	جهاز دراسة الاحتكاك داخل أنبوبة	(مستعمل)	H249566	1
11-1	ترابيزة هيدروليكية كاملة	بمقياس بوردون للضغط ومعة ... مضخة وموتور 240/250 فولت،	H650367, H648267, H651367, H653367	4
12-1	التربينة المحورية Flow Pump Axial Turbine	(مستعمل)	H26	1
13-1	خزان وعمود لجهاز دراسة الاحتكاك			1
14-1	ايجاد معامل السحب للأشكال Flow Apparatus Visualisation	(مستعمل)	H14	1
15-1	Digital Strain Bridge قنطرة الانفعال الرقمية		E31	1
16-1	جهاز يسمى الدائرة الهيدروليكية لقياس الأنابيب الدوارة			1
17-1	مضخة نافورية بصمام ضغط خلف الكابل	(مستعمل)		1
18-1	جهاز قياس الرطوبة مع ضغط كهربائي منخفض Tensiometer	(مستعمل)		1
19-1	مضخة طاردة مركزية ذات مرحلتين	عدد 2 موتور 380 فولت لكل موتور عداد خاص وميزان زنبركي و 2 مفتاح تشغيل و 4 مقياس ضغط و طقم مفتاح بلدي 6 قطع	34V31V1, 35268W1	1
20-1	مجري الفيضان المائي	بقصر زجاج كامل بالماتور 240/220 فولت واحد حصان ومعه حامل جهاز قياس العمق مدرج بالورنية وعداد قياس التصريف	338/66	1
21-1	نموذج قنطرة حجم المياه 21*78*108 سم من الخشب السويد بدون دهان			1
21-1	وحدة تربينة (عجلة بلتون) ذاتية التشغيل	تشمل تربينة وخزان ودينامتر 2 سرعة وظلمبة رقم P135787 وموتور 260/235 فولت و بدء التشغيل 2793/27 - 440/200 فولت وحامل متحرك والماكينه كاملة ومعها		1

		غطاء من القماش السميك بلون أخضر		
1		تشمل تربيئة وخزان ودينامتر 2 سرعة وظلمبة رقم P135788 وموتور 290/235 فولت و بدء التشغيل 2193/21 - 440/200 فولت وحامل متحرك والماكينة كاملة ومعها غطاء من القماش السميك بلون أخضر	وحدة تربيئة (فرانسييس) ذاتية التشغيل	22-1
1			جهاز Ground Water Flow Unit سريان المياه الجوفية	23-1
1	216		قناة أرضية معملية من خشب السويد	24-1
1		200*61*20 سم صاج أسود ، وحديد زاوية 40*40*4مم	قناة صاج أسود	25-1
1		بطول 12 متر وعرض 1.50 متر وارتفاع 1.0 متر - القناة صاج مجلفن 1.50 مم وحديد زاوية 4*40*40 مم و 3*30*30 مم وعدد 2 خزان 100*120*40 سم صاج مجلفن 1.5 مم - صفحة (108) قديم	جهاز مجمع باسم قناة مائية معملية	26-1
1		صندوق رمال صغير	جهاز مجمع، دراسة حركة المياه خلال التربة	27-1
1		القناة المعملية 175*100*100 سم، بطول 13 متر صاج مجلفن 2 مم وحديد زاوية 40*40*5 مم بدهان البرايمر واللاكه (صفحة 153) قديم	جهاز قياس الامواج	28-1
1		(مستعمل)	نموذج صندوق الرمال Sand Box Model	29-1
1			Basic Hydraulic Bench	30-1
1			Energy Loses in Pilpes	31-1
1			Bernoulli Experiment	32-1
1			Pipes Surge Apparatus	33-1

عدد	مسلسل	المواصفات والملحقات	2- أجهزة القياس	
1	3820	(مستعمل)	أفوميتر ياباني	1-2
1		(مستعمل)	بارومتر مركب وبه ترمومتر	2-2
1	H750467		جهاز قياس التصريف	3-2
1	16248	به ورنية دقة 10/1 من الميليمتر وقضيب مدبب والجهاز رقم 16248 ومعه قاعدة لتثبيت الورنية	جهاز قياس العمق الميكانيكي لغاية 600 مم	4-2
1	16250	به ورنية دقة 10/1 من الميليمتر وبه عدد 2 قضيب مدبب كامل باللمبة والجهاز رقم 16250 ومعه قاعدة لتثبيت الورنية	جهاز قياس العمق الكهربائي لغاية 600 مم	5-2
1	13035	بثقل قطر 250 مم ومعه عدد 2 ماسك	جهاز قياس المستوي قطر 300 مم	6-2
5			ساعة إيقاف صناعة سويسري	7-2
1		(مستعمل)	جهاز الأوسيليسكوب Dual Trace Oscilloscope	8-2
1			مانومتر إلكتروني Electronic Manometer	9-2
1			Pressure Transducer حساس ضغوط	10-2
1		ملحق قضيب و مراوح بلاستيكية وكابل وساعة إيقاف ومفكات وكتالوج	جهاز قياس سرعة السريان في الحقل	11-2
1		كامل بمفتاح الايقاف لقياس 5000 لفة مكون من ثلاث دوائر داخل علبة (مستعمل)	عداد سرعة تاكومتر Tachometer	12-2
1		كامل بالحجارة والمفتاح (مستعمل)	عداد سرعة طراز F4	13-2
1		مراوح وقضيب وكابل توصيل 4 متر وساعة إيقاف	جهاز قياس سرعة السريان Current meter	14-2
1		(مستعمل)	جهاز قياس سرعة السريان-رصاصي كبير Current meter	15-2
1	2012	يقيس لعمق 100 متر صناعة ألمانيا الغربية ماركة Richter	جهاز قياس منسوب سطح المياه يعمل بالبطارية	16-2
1		145 psi	Pressure Transducer حساس ضغوط	17-2
1			ميكرومتر	18-2
1		H12-9 Basic Portable Pressure Meter (140 mBar)	Pitot tube 450 mm - Model H30-3H جهاز قياس سرعة السريان	19-2
1		Micro ADV 16 mhz, Splash-proof System	جهاز قياس السرعات على 3 اتجاهات	20-2
			Digital Hook & Point Gauges (H1-7: 300mm)	21-2
1			جهاز قياس الأمواج وحساسات الضغوط	22-2
2		Temperature Sensor (Fixed Infrared) Temperature Transducer with Configurable Via USB Connection to PC -(OS151-USB)	حساس قياس درجة الحرارة	23-2
5		Pressure Transducer High performance, Rugged All Stainless Steel Construction (PX309-030G5V)	حساس قياس الضغط	24-2

1	Portable 4 to 8 Channel Data Logger - Omega Model No. SQ2010 + Carrying Case + 2 Cell Batteries + Input Terminal Block + Screwdriver + USB Cable + OM-SQ-Software + AC Adapter	Data Logger مسجل بيانات محمول	25-2
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عدد	مسلسل	المواصفات والملحقات	3- أجهزة الحاسب	
1		Intel P4 -MB-GB intel 945 - ATX P4 -350 watt - Mic Keyboard - Opt. mouse - RAM 512 MB DDR11533 - FDD 3.5 -1.44 MB- S.Woofier 1000 watt - Headset - Pad - . Monitor 17 inch Flat	جهاز كمبيوتر بالمواصفات	1-3
1		Dell Precision T7910 Workstation - Memory 128GB 2133MHz DDR4 (8x16GB RDIMM ECC - Processor: Intel® Xeon® Processor E5-2650 v3 (10C, 2.3GHz, 25M, 105W) - Video Card: NVIDIA Quadro K4200 4GB (2DP, DL-DVI-I) (1 DP to SL-DVI adapter) - Hard Drive: 3.5 inch 2TB SATA 7.2K RPM HDD - Dell U2412M Monitor, Silver, EUR * Patr Number (U2412m)	جهاز حاسب آلي DELL Workstation	2-3
1		* Mothrboard: Intel E5200 2.5GHz 2MB Foxconn G41 - Processor: Intel® Core i3 4th generation processor - Memory: 2GB DDR2 - Hard Drive: 320 GB WD HDD - DVD: R/W Samsung - LAN integratwd - Case: ATX - Keyboard: PS2- Opt. mouse - Monitor: LG 14 inch LCD - Sound integratwd - Card Wireless	جهاز حاسب آلي شامل الشاشة (مكتب د/زيدان) 2010	3-3
1		* M920 i7	جهاز حاسب آلي لينوفو شامل الشاشة (مكتب د/زيدان)	4-3
2		* Mothrboard: Intel Chipset M81 with integrated (VGA-LAN-Sound) Gigabite - Processor: Intel® Core i3 4th generation processor - Memory: 4GB DDR3 - Hard Drive: 500 GB SATA 7200 RPM HDD - DVD: R/W Samsung - VGA Card: Force Nvidia 4G - USB Keyboard - Opt. mouse - Monitor: 18.5 inch LED Samsung	جهاز حاسب آلي	5-3
		Canon i-SENSYS LBP6030B	طابعة ليزر كانون	6-3

عدد	مسلسل	المواصفات والملحقات	4- أجهزة العرض والتصوير والاتصال	
1			بروجيكتور Over Head Projector	1-4
1			Reflecta AF 35 mm Slide Projector شرايح بروجيكتور عرض	2-4
1			Projection Screen شاشة عرض	3-4
1		مرفق معها حامل ثلاثي 2 إسطوانة تسجيل، والشنطة الخاصة بها	كاميرا رقمية SONY CD 500	4-4
1		InFocus IN124A data projector Standard throw projector 3500 ANSI lumens DLP XGA (1024x768) 3D compatibility Black - مرفق وحدة - نعليق اليقف + كابل توصيل	داتا شو	5-4
عدد	مسلسل	المواصفات والملحقات	5- ظلمبات وأجهزة كهربية	
1		طراز NTO-200 على شاسية من كمر حديد مع محرك قدرة 40 حصان إيطالي 380 فولت	ظلمبة رفع مياه ماركة كالبيدا متنتلة	1-5
1		قدرة 1.5 حصان - طراز DLM109	ظلمبه غاطسه	2-5
1		قدرة 1.1 ك وات عند سرعة 21 لفة - ثلاثي الأوجه - 380/220 فولت	محول كهربائي بالجير بوكس	3-5
1		حصان 2.50	جهاز تكييف	4-5
عدد	مسلسل	المواصفات والملحقات	6-معدات وخامات	
1		بلقمة صلب (مستعمل)	منجلة زهر	1-6
1		(مستعمل)	مشحمة يدوي 2*1	2-6
1			طقم مفتاح بلدي 12 قطعه	3-6
1		(مستعمل)	فلانشة نحاس أصفر بها سلبه خارجية، خارجي 15 مم، داخلي 54 مم، عرض 65 مم	4-6
1		(مستعمل)	ماكينة جليخ 6 بوصة حجرين الماني	5-6
1		(مستعمل)	زرجينة رولمان بلي 6 بوصة 3 رجل	6-6
5			المونيوم زاوية - 3 متر - 3*3*3	7-6
6			كوع 3 بوصة مستورد	8-6
1			محبس سكينه 3 مستورد	9-6
18			مواسير حديد 3 بوصة مجلفن ثقيل	10-6
1			كوع 3 بوصة	11-6
1			قفل 2.5 بوصة	12-6
10			قرص خشب	13-6
1			اكريك شفاف 130*200سم	14-6
2			قفل 2.5 بوصة	15-6

سادساً: قائمة بالتجارب التي تؤدي داخل المعمل (مرحلة البكالوريوس)

م	التجربة	الغرض منها
1	دراسة ثبات الجسم العائم (Stability of the floating body)	يستخدم الجهاز فى قياس ثبات الأجسام الطافية ودورانها واتزانها.
2	جهاز قياس التصرف من خلال فتحة دائرية (Discharge through an Orifice)	يستخدم الجهاز لتوضيح كيفية حساب التصرف عن طريق عبور المياه خلال فتحة دائرية.
3	السريان فوق الهدارات (Flow over weirs and notches)	يستخدم الجهاز لتوضيح كيفية حساب التصرف عن طريق عبور المياه فوق هدار مثلث الشكل
4	الفواقد خلال خطوط المواسير والشبكات (Friction loss in pipes and networks)	يستخدم الجهاز لتحديد الفواقد الرئيسية خلال خطوط المواسير
5	الضغط الهيدروستاتيكي علي الاسطح المغمورة (Hydrostatic pressure on submerged surfaces)	يستخدم الجهاز لتحديد الضغط الهيدروستاتيكي علي البوابات و تحديد مركز الضغط
6	السريان خلال الفتحات (flow through orifices)	يستخدم الجهاز لتحديد معاملات السرعة والإختناق والتصريف
7	السريان خلال الفنشوريمتر (Flow through Venturi-meter)	يستخدم الجهاز لتحديد التصريف خلال الأنابيب
8	المطرقة المائية (water hammer)	قياس سرعة موجة الطرق
9	القفزات الهيدروليكية (Hydraulic jumps)	تصميم الفرشة الخرسانية خلف منشآت الحجز

سابعاً: الخدمات المجتمعية التي يؤديها المعمل

جاري تطوير المعمل لكي يستطيع ان يؤدي خدمات مختلفه لقطاع الإنتاج وتنفيذ المشروعات ومنها:

- إختبارات التحميل الهيدروليكي للمواسير والمحابس والكيعان وكافة الوصلات إختبارات الضخ وخصائص ظلمبات الرفع
- تجارب السريان غير المستقر بالقنوات المفتوحة بالمواسير
- قياسات الملوحة والمعاملات التي تحدد علاقات المياه والتربة والنبات.
- قياس السرعات و حساب التصرفات فى القنوات الحقلية المبطنه و الغير مبطنه.
- عدد المستفيدين من المعمل: لا يوجد
- الجهات التي تتعاون مع المعمل: لا يوجد
- الدخل السنوي للمعمل: لا يوجد
- الجهات الممولة لأنشطة المعمل: لا يوجد
- المشاريع التنافسية التي يشارك فيها المعمل: لا يوجد

ثامناً: الخدمات الطلابية التي يؤديها المعمل

- وتشمل التجارب التي تجري في المعمل لشرح الظواهر الطبيعية والتطبيقات العملية الخاصة بمواد ميكانيكا الموائع، هيدروليكا، نظم الري والصرف، هندسة الموانئ.
- عدد الطلاب المستفيدين من المعمل: حوالي 1000 طالب
- الأقسام العلمية المستفيدة من المعمل: الهندسة المدنية
- الفرق الدراسية المستفيدة من المعمل: الأولي مدني – الثالثة مدني – الرابع مدني
- المقررات الدراسية التي تستفيد من المعمل: هيدروليكا (1) – هيدروليكا (2) – الموانئ والملاحة الداخليه
- الأنشطة الطلابية داخل المعمل: لا يوجد
- عدد الدورات التدريبية التي تمت في المعمل: لا يوجد
- المسابقات العملية التي شارك فيها طلاب من المستفيدين من المعمل: لا يوجد

تاسعاً: الخدمات البحثية

وتشمل الدراسات البحثية التي تجري في المعمل يقوم بها بطلبة الدراسات العليا والساده أعضاء هيئة التدريس لدراسه السريان السطحي، حركة المياه الجوفية، حركة المواد الرسوبية، وغيرها.








■ عدد طلاب الدراسات العليا المستفيدين من المعمل: 4 طلبة



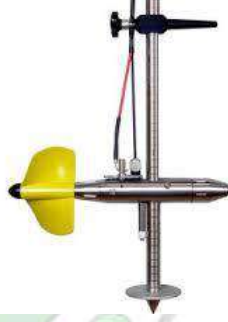

■ عدد الرسائل العلمية التي تمت في المعمل: حوالي 20 رسالة







عاشراً: صور للأجهزة بالمعمل

#	Item/Instrument	Key Specs	Image
1	Full hydraulic bench with Borden pressure gauge	This is a basic unit that provides water supply and gravimetric measurement services for use in conjunction with other accessories for specific experiments	
2	Hydraulics Bench- FME00	The Hydraulics Bench, "FME00", is formed by a movable hydraulics bench used to hold a wide variety of modules, which allow the student to experiment with the problems presented by fluid mechanics.	
3	Photon Basic Hydraulic Bench	Photon Basic Hydraulic Bench is equipment fluid mechanics laboratory. The flow over weirs experiment is included in Basic Hydraulic Bench.	
4	Bernoulli's principle demonstrator	Demonstration of Bernoulli's theorem, the sum of pressure energy + Kinetic energy + potential energy = constant.	
5	Flow over weirs	Study of the flow characteristics through a weir with a rectangular weir, square, trapezoidal and circular weir	
6	Hydrostatic pressure apparatus	Studying the center of pressures for partial immersion.	

#	Item/Instrument	Key Specs	Image
8	Impact of jets	Determine the impact of jets against a flat surface, a curve surface of 120 and a hemispherical surface.	
9	Metacentric Height	Study the stability of a floating body at different positions of the center of gravity.	
10	Surge tank and water hammer unit	Investigating the effects of pipe hammer caused by a fast closing valve, Measuring the pressure profile of hammer, and Demonstration of water level oscillations in the surge tank.	
11	Dead Weight Pressure Gauge Calibrator	This calibrator functions on the same principle adopted in calibrating industrial pressure gauges.	
12	Friction loss in pipes	Flow through pipes of differing diameters under laminar and turbulent flow conditions. Investigations of the flow/pressure drop relationship for an annular pipe.	
13	Ground Water Flow Unit	Demonstrate ground water flow and the resulting hydraulic gradients, including the effect of permeability. Demonstrate cone of depression for a single well in an unconfined aquifer	
14	Vernier Hook & Point Gauges	The measurement of steady state water surface position is frequently needed during hydraulic investigations.	

#	Item/Instrument	Key Specs	Image
15	Free and forced vortex apparatus	Experiment to plot the shape of a free vortex by measurement of the surface profile coordinates, and thus verify that " $v r = c$ " where v is the speed and " r " is the radius of the vortex	
16	Flow channel with width 7.5 cm	<ol style="list-style-type: none"> 1. Study of uniform flow in inclined channel, verification of Chézy equation and determination of Chézy coefficient and Manning's friction factor. 2. Study of flow under a sluice gate (undershot weir) with application of specific energy and momentum functions. 3. Hydraulic jump – determination of energy head and power loss at the jump section by means of specific energy considerations. 	
17	Field Current Meter	Current Meter is designed for flow velocity measurements in combination with hand-held wading rods or cable suspended from a bridge or boat.	
18	Counter set of current meter flow measurements	It automatically records the number of propeller revolutions by counting the impulses. Besides, it can output the velocity of flow immediately	

#	Item/Instrument	Key Specs	Image
19	Acoustic Doppler Velocimeter (ADV)	The ADV is a single point, high-resolution Doppler current meter which provides 3-D velocity measurements in a remotely sampled volume.	
20	Laboratory channel (Wave Flume)	Its rigid steel bed raises 1.16 m from the laboratory ground level. The total length of the flume consists of head tank 1.00 m long, an approaching steel part 10.5 m long, working section made from Perspex 2.6 m long, and the tail tank 1.00 m long. The flume is equipped with a variable speed flap type wave generator and a porous screen filled with uniform gravel at one end of the flume.	 
21	Open channel laboratory flume	Large open channel flume that provides the opportunity for advanced research and student study on a wide range of fluid flow topics.	
22	Open channel laboratory flume (Steel)	flume for student study and advanced research into a wide range of fluid flow topics. A huge range of ancillaries is available to extend learning potential and offers the opportunity for innovative experimentation.	

1.1. General Information

- Experiment name: *Stability of the floating body*
- Second year civil engineering
- First term

1.2. Apparatus Description

The apparatus is arranged from a rectangular sheet metal pontoon floats in water and carries stem braced with cords, Figure (1.1.a). From this a plumb-bob is suspended so that the angle of list of the pontoon may be read off a scale marked in degrees. The height of the center of gravity of the floating body may be varied by an adjustable weight which slides up and down the stem. A jockey weight is arranged to slide along a bar fixed on the pontoon parallel to its base; as this weight is moved by known intervals, the change in angle of list is noted, and the stability of the pontoon thereby measured.

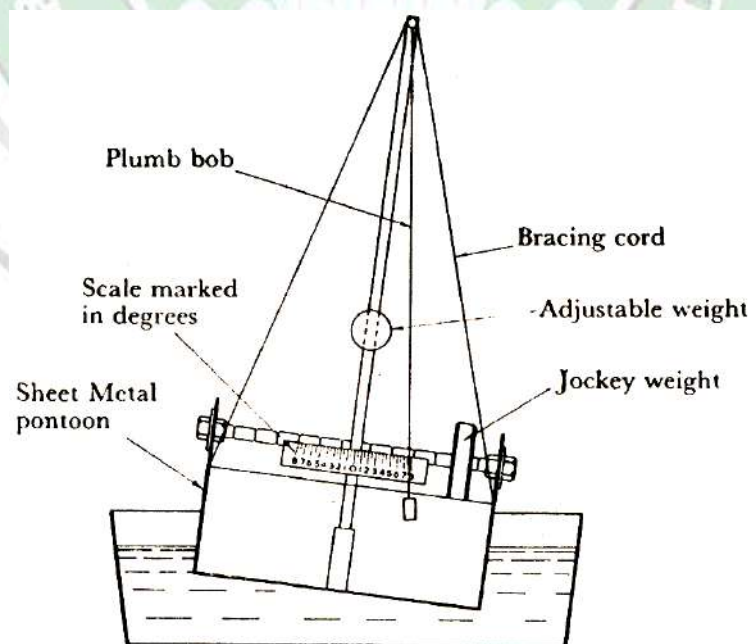


Figure (1.1.a): Arrangement of floating pontoon

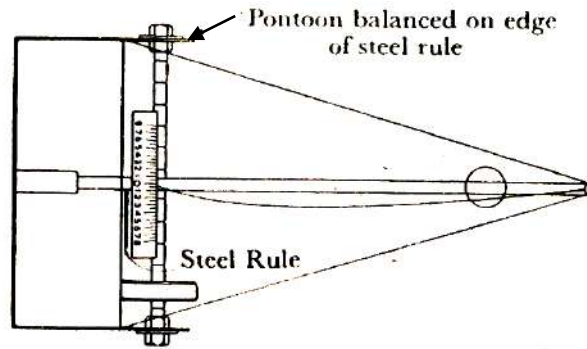


Figure (1.1.b): method for finding height of centre of gravity

1.3. Theoretical Background

Consider the rectangular pontoon floating in equilibrium on even keel, Figure (1.2.a). The weight of the floating body acts vertically downwards through its center of gravity (G) and this is balanced by an equal and opposite buoyancy force acting upwards through the center of buoyancy (B), which lies at the center of the gravity of the liquid displaced by the pontoon.

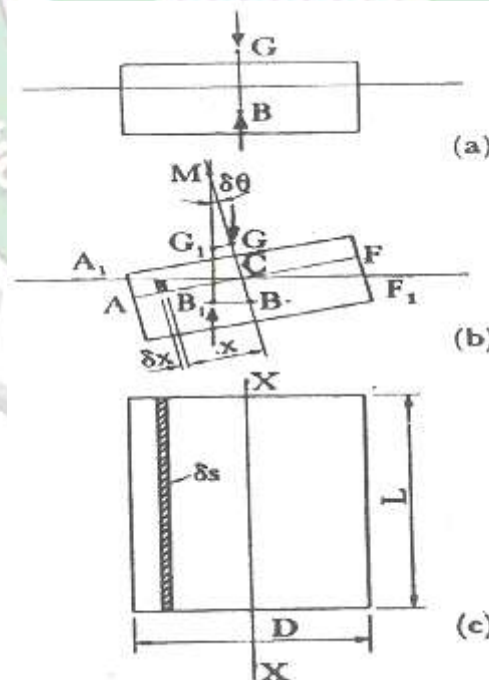


Figure (1.2): Derivation of stability of floating pontoon

To investigate the stability of the system, consider a small angular displacement ($\delta\theta$) from the equilibrium position as shown in Figure (1.2.b). The center of gravity of liquid displaced by the pontoon is shifted from (B) to (B₁). The vertical line of action of the buoyancy force is shown in the figure and intersects the extension of line (BG) in (M), called *the metacenter*.

The equal and opposite forces through (G) and (B₁) exert a couple on the pontoon, provided that (M) lies above G as shown in Figure (1.2.b). This couple acts in the sense of restoring the pontoon to even keel (i.e. the pontoon is stable). If, however, the meta-center (M) lies below the center of gravity (G), the sense of the couple is to increase the angular displacement and the pontoon is unstable. The special case of neutral stability occurs when (M) and (G) coincide. Figure (1.2.b) shows clearly how the meta-center height (GM) may be established experimentally using the jockey weight to displace the center of gravity sideways from (G). Suppose the jockey weight (m) is moved a distance equal to (δx_1) from its central position, if the weight of the whole floating assembly is W, then the corresponding movement of the center of the gravity of the whole pontoon, in a direction parallel to the base of the pontoon, is $\frac{m}{W} \delta x_1$.

If this movement produces a new equilibrium position at an angle of list ($\delta\theta$), then in Figure (1.2.b), (G₁) is the new position of the center of the gravity of the whole pontoon:

$$GG_1 = \frac{m}{W} \delta x_1 \quad (1.1)$$

from the geometry of the figure:

$$GG_1 = GM \cdot \delta\theta \quad (1.2)$$

eliminating (GG_1) between these two equations we derive the following equation:

$$GM = \frac{m \delta x_1}{W \delta \theta} \quad (1.3)$$

or, in the limit form:

$$GM = \frac{m}{W} \left(\frac{dx_1}{d\theta} \right) \quad (1.4)$$

The metacentric height may thus be determined by measuring $\left(\frac{dx_1}{d\theta} \right)$ by knowing the values of both (m) and (W).

1.4. Experimental Procedure

Firstly the weight of the various components of the floating assembly are noted and the length and width of the pontoon carefully measured by steel rule. The stem is then fitted into its housing in the pontoon and is rigidly braced by drawing the cords tight.

The height of the center of the gravity of the pontoon above the base is then established by turning it on its side and supporting it at the stem on the edge of a steel rule, to obtain the point at which it balances with the base of the pontoon vertical as indicated in Figure (1.1.b). To obtain a convenient point of balance it may be necessary to move the adjustable weight along the stem to a suitable position. While the pontoon is turned on its side, the plumb-bob line should be looped round the scale to keep the plumb-bob approximately in its normal relative position. The point of balance is marked and the height of this point and the adjustable weight above the base is measured by steel rule. It is convenient to refer dimensions of the sheet should be added to measurements made upwards from the inner with the adjustable weight in one known position; its height may be calculated for any other position of the adjustable weight.

The pontoon is now allowed to float in water. It is convenient, but by no means necessary, to move the adjustable weight sideways so that the angle of tilt is zero when the jockey weight is in its central position. Angles are then recorded for various positions of the jockey weight to both sides of the center, the maximum displacement being determined by maximum angle which may be recorded on the scale marked off in degrees. The procedure may be repeated with the adjustable weight set at a number of different heights.

1.5. Results and Calculations

Total weight of floating assembly, $W = 5.39 \text{ lb}$

Jockey weight, $m = 0.50 \text{ lb}$

Adjustable weight = 1.00 lb

Breadth of pontoon, $D = 8.02 \text{ in}$

Length of pontoon, $L = 14.10 \text{ in}$

Second moment of area, $I = LD^3/12 = 606 \text{ in}^4$

Volume of water displaced $V = 5.39/62.4 = 149.3 \text{ in}^3$

$$\therefore BM = \frac{I}{V} = 4.06 \text{ in}$$

Depth of pontoon immersion = $V/LD = 1.32 \text{ in}$

Depth of center of buoyancy, $CB = 1.32/2 = 0.66 \text{ in}$

Height of meta-center above water surface, $CM = BM - CD = 4.06 - 0.66 = 3.40 \text{ in}$

All above results are shown in Figure (1.3).

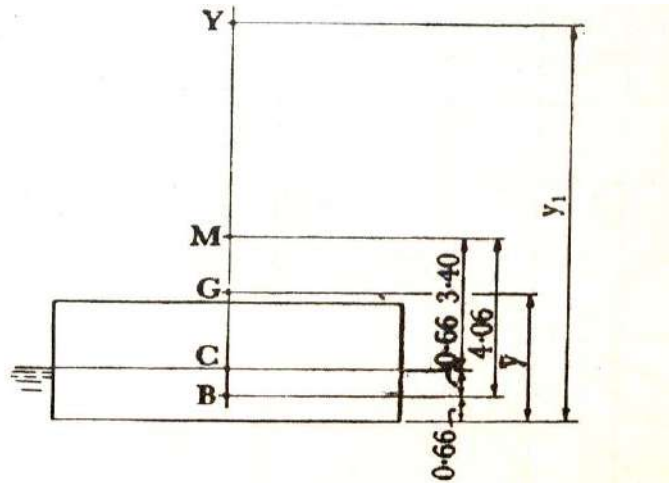


Figure (1.3): Diagram showing calculated dimensions

When the pontoon was turned on its side and balanced at the stem on the edge of a steel rule, the following result was obtained.

- Height of adjusted weight above base = 10.27 in
- Height of G above base = 3.22 in

Now the height y of (G) above the base will vary with the height (y_1) of the adjustable weight above the base according to the equation

$$\bar{y} = \frac{y_1}{5.39} + A$$

where A is constant.

Since the ratio of the adjustable weight to the weight of the whole pontoon is 1 : 5.39. By substituting in the above equation the value of A is calculated as follows:

$$3.22 = \frac{10.27}{5.39} + A$$

$$\therefore A = 1.31 \text{ in}$$

So that

$$\bar{y} = \frac{y_1}{5.39} + 1.31 \text{ in}$$

Referring to Figure (1.3), the height of (G) above the water surface is:

$$CG = \bar{y} - 1.32$$

$$CG = \frac{y_1}{5.39} - 0.01 \text{ in}$$

Measurements of angles of tilt produced by moving the jockey weight, with the adjustable weight set at various heights, are given in Table (1.1) and are presented graphically in Figure (1.4). The calculation of meta-centric height from the results is set out in Table (1.2). For example, when $y_1 = 5.62$ in, the value of $\left(\frac{dx_1}{d\theta}\right)$ read from the graph is found to be 0.443 in per degree, or 0.443×57.3 in per radian.

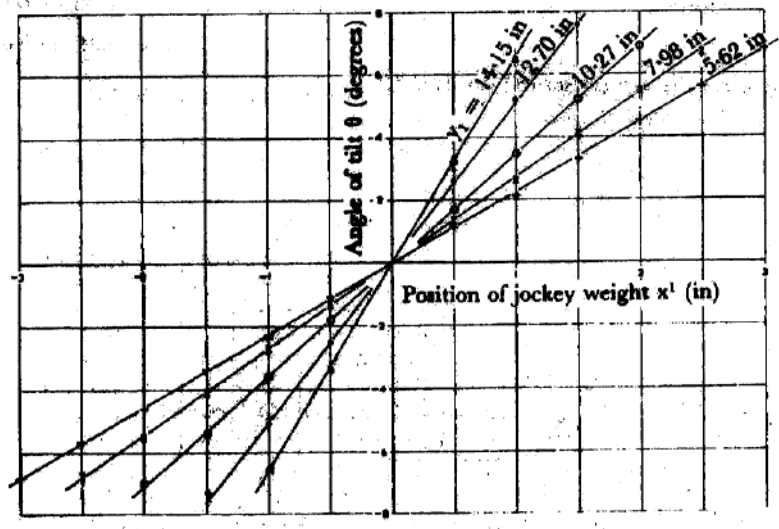


Figure (1.4): Variation of angle of tilt with position of jockey weight

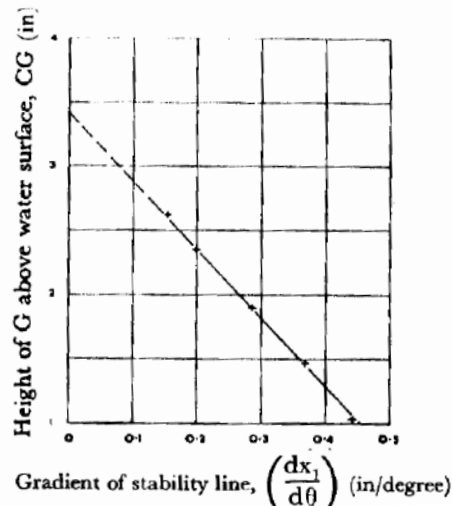


Figure (3.5): Variation of stability with height of centre of gravity

Table (3.1): Values of angles of tilt, θ (degree)

Ht. of adjustable Weight, y_1 (in)	Position of jockey weight, x_1 (in)												
	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3
5.62	-6.8	-5.7	-4.6	-3.4	-2.3	-1.1	0.0	1.1	2.1	3.3	4.5	5.6	6.8
7.98	-	-6.7	-5.5	-4.1	-2.7	-1.3	0.0	1.3	2.6	4.1	5.5	6.7	-
10.27	-	-	-7.0	-5.4	-3.6	-1.8	0.0	1.7	3.5	5.2	6.9	-	-
12.70	-	-	-	-7.3	-5.1	-2.5	0.0	2.6	5.2	7.6	-	-	-
14.15	-	-	-	-	-6.5	-3.4	0.0	3.3	6.5	-	-	-	-

Table (3.2): Derivation of metacentric height from experimental results and comparison with calculations.

Ht. of Adjustable Weight y_1 (in)	Height of G above water surface, CG (in)	$\left(\frac{dx_1}{d\theta}\right)$ (in/degree)	Metacentric height GM. (in)	Height of M above water surface, CM. (in)
5.62	1.03	0.443	2.35	3.38
7.98	1.47	0.368	1.96	3.43
10.27	1.90	0.286	1.52	3.42
12.70	2.35	0.198	1.05	3.40
14.15	2.62	0.154	0.82	3.44

$$GM = \frac{m}{W} \left(\frac{dx_1}{d\theta} \right) = 2.35 \text{ in}$$

$$CG = \frac{y_1}{5.39} - 0.01 = 1.03 \text{ in}$$

$$CM = GM + CG = 2.35 + 1.03 = 3.38 \text{ in}$$

1.6. General Questions

- 1- What suggestions have you for improving the apparatus?
- 2- How would the stability of the pontoon be affected if it were floated on a liquid with a density greater than that of water?

EXPERIMENT (2)

2.1. General Information

- Experiment name: *Discharge through an orifice*
- Second year civil engineering
- First term

2.2. Apparatus Description



The following figure shows the arrangement of the tank which is fed from the bench supply valve through a sprinkler pipe distributes the water over perforated screen. The water passes down the tank through a second screen which serves to stabilize the flow, and leaves through a sharp edged orifice which is fitted into the base of the tank in such a way that there is no unevenness along the inner surface.

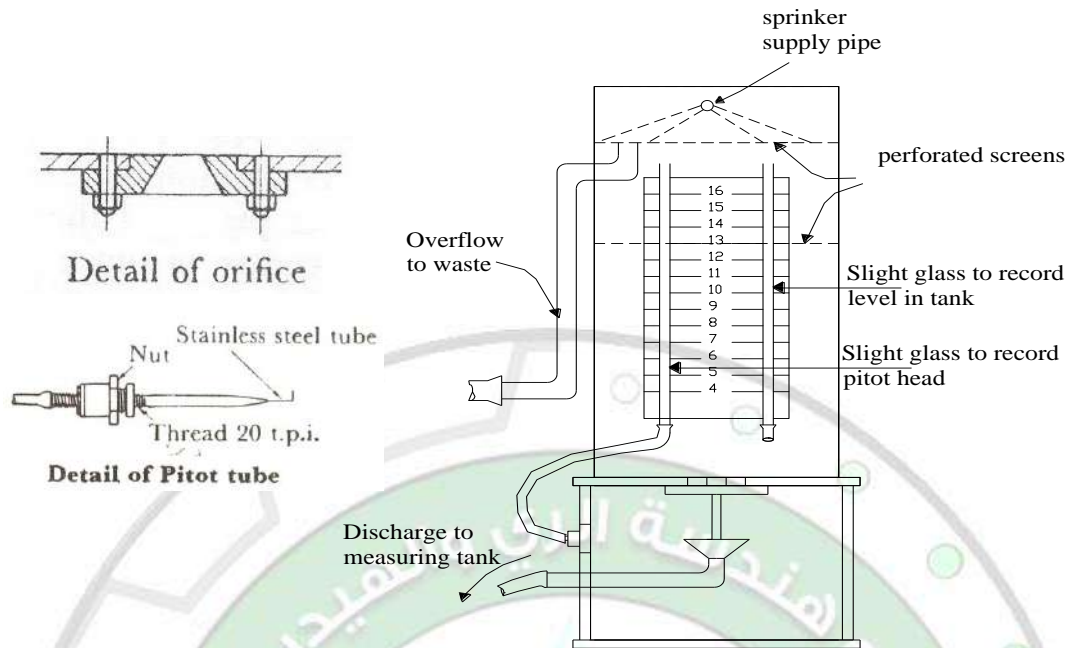


Figure (2.1): Arrangements of orifice apparatus

2.3. Experimental Procedure

The experiment may be divided into two parts, firstly, the measurement of C_d , C_u , and C_c at a single constant value of H_o , and, secondly, measurement of discharge at a number of different values of H_o . In the first part of the experiment, water is admitted to the tank to allow it to fill to the height of the overflow pipe and the inflow is regulated so that a small steady discharge is obtained from the overflow. To measure C_u , the pitot tube is inserted into the emerging jet close to the underside of the tank, the values of H_c , and H_o are noted. To measure C_c it is necessary to find the diameter of the jet at the vena-contracta. In the second part of the experiment, the inflow to the tank is reduced to lower the level in the tank in stages, the discharge from the orifice being measured at each stage.

2.4. Results and Calculations

- Diameter of orifice = 0.497 in
- Cross-sectional area, $a_o = 0.194 \text{ in}^2$
- Head of orifice, $H_o = 14.86 \text{ in}$
- Time required to collect 30 lb of water = 65.6 sec
- Discharge , $Q = 0.00733 \text{ cusecs}$
- Pitot tube reading, $H_c = 14.84 \text{ in}$
- Diameter of jet = 0.391 in.

$$C_d = \frac{Q}{\sqrt{2gH_o a_o}}$$

$$C_d = \frac{0.00733}{\sqrt{64.4 \times 1.23 \times 0.001347}}$$

$$C_d = 0.61$$

$$\text{Coefficient of velocity, } C_u = \sqrt{\frac{H_c}{H_o}}$$

$$C_u = 0.999$$

$$\text{Coefficient of contraction } C_c = \frac{a_c}{a_o}$$

$$C_c = 0.619$$

Table (2.1): Measurements of H_o and Q

Qty. lb	t sec	H_o		Q cuses	$H_o^{0.5}$ ft ^{0.5}
		in	ft		
30	65.6	14.9	1.23	.00733	1.11
30	68.8	13.5	1.12	.00699	1.05
30	71.4	12.2	1.01	.00673	1.0
30	77.2	10.6	0.88	.00623	0.93
30	82.6	9.14	0.76	.00582	0.87
30	90.0	7.52	0.62	.00534	0.79
30	101.6	6.01	0.5	.00473	0.70
30	112	4.8	0.4	.00429	0.63

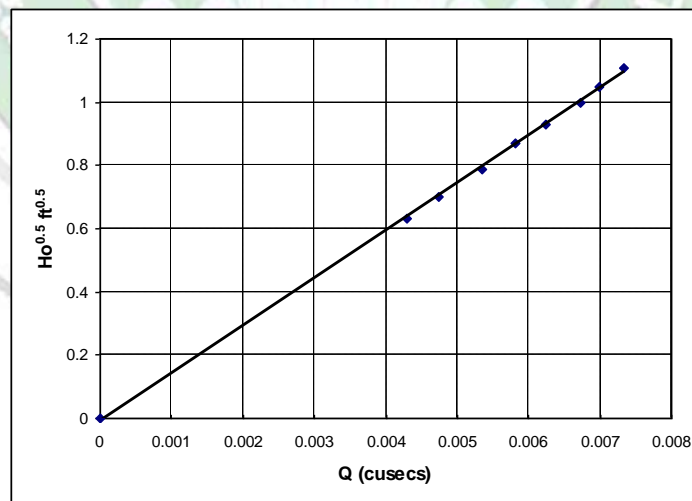


Figure (2.2): Variation of $H_o^{0.5}$ with Q for discharge through an orifice

EXPERIMENT (3)

3.1. General Information

- Experiment name: *Flow over weirs and notches*
- Second year civil engineering
- First term

3.2. Apparatus Description

The following figure shows the arrangement in which water from the bench supply valve is led through a flexible hose to three short perforated pipes which serve to distribute the water fairly evenly in the enlarged end of the tank. A contraction section leads the water to a short channel, in the end of which a plate may be plotted, notched rectangular or V-shape. The construction is such that the internal surfaces of the tank and plate are flush and edges of the notch are sharp.

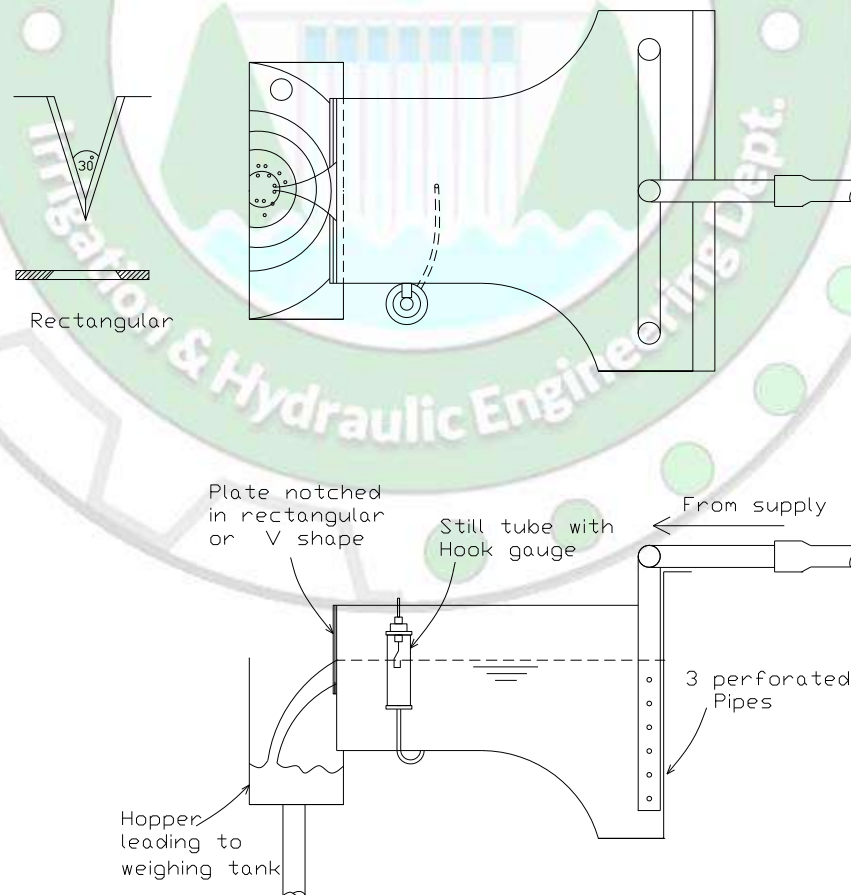


Figure (3.1): Arrangement of apparatus for measuring flow over weirs



3.3. Experimental procedure

The main purpose of this experiment is to estimate the coefficient of the venturi-meter C_d . The apparatus is first leveled and the zero of the hook gauge is established (i.e. the hook gauge reading corresponding to the level of the crest of the notch). To do this, water is admitted from the bench supply to the apparatus until the level is approximately correct, and then carefully baled out or in, using a small beaker, until the crest of the wear lies just in the surface. The reflection of the V in the surface serves to indicate whether the level is correct or not. When the correct level has been obtained, the hook gauge is set in the water surface in the still tube and the zero reading taken.

The equation of the rectangular notch is given by:

$$(3.1) Q_{th} = \frac{2}{3} B \sqrt{2g} \cdot H^{3/2}$$

The equation of the triangular V- notch is given by:

$$(3.2) Q_{th} = \frac{8}{15} \sqrt{2g} \cdot \tan \theta \cdot H^{5/2}$$

where: $\theta = 30^\circ$

$$(3.3) Q_{act} = \frac{1000w}{t} \text{ cm}^3 / \text{sec}$$

$$(3.4) C_d = \frac{Q_{act}}{Q_{th}}$$

The relationship between $\log(Q)$ and $\log(H)$ is driven as follows:

$$\text{Log}(Q) = 2.5 \text{Log}(H) + 0.1392 \quad (3.5)$$

from which:

$$Q = 0.7 H^{2.5} \quad (3.6)$$

3.4. Experimental Steps

The followings explain the steps of the experiment:

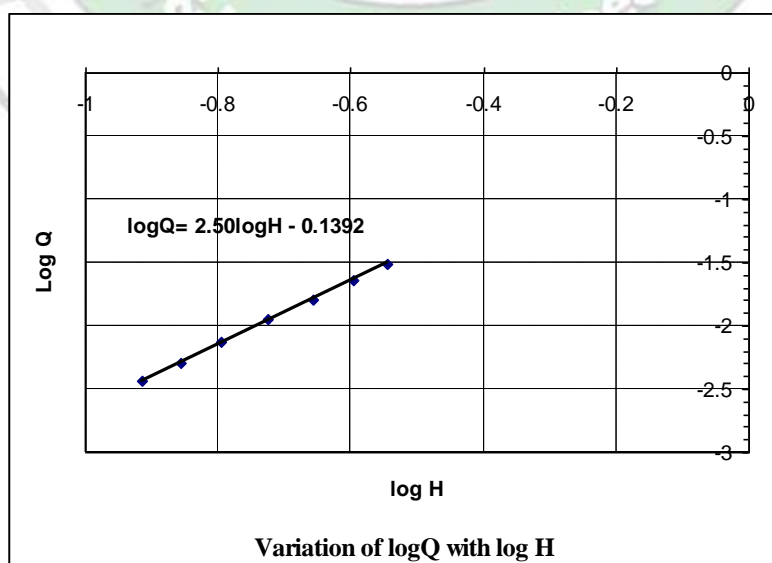
- Run the apparatus and measure the value of H_o
- Waiting until the water surface to be in a specified level then measure the value of H_1 and calculate the value of H .
- Calculate the value of Q_{th} .
- Determine the required time until balance occurs.
- Calculate the value of Q_{act} .
- Calculate C_d .
- Repeat the previous steps with changing the value of H_1 .

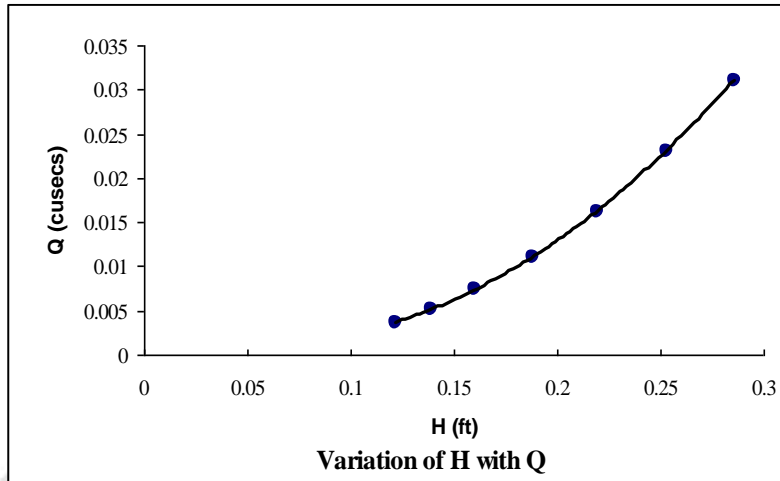
3.5. Results

H ft	Q	T sec	Q cusecs	logQ	logH
0.2857	90	46.4	0.03108	-1.508	-.544
0.2529	90	62.6	0.02304	-1.638	-.597
0.2197	60	59.4	0.01619	-1.791	-.658
0.1881	60	86.6	0.01110	-1.955	-.726
0.1604	30	64.8	0.00742	-2.130	-.795
0.1393	30	93.6	0.00514	-2.289	-.856
0.1217	30	132.6	0.00363	-2.440	-.915

3.6. Discussion

From the notch equation the value of C_d can be calculated $C_d = 0.6$





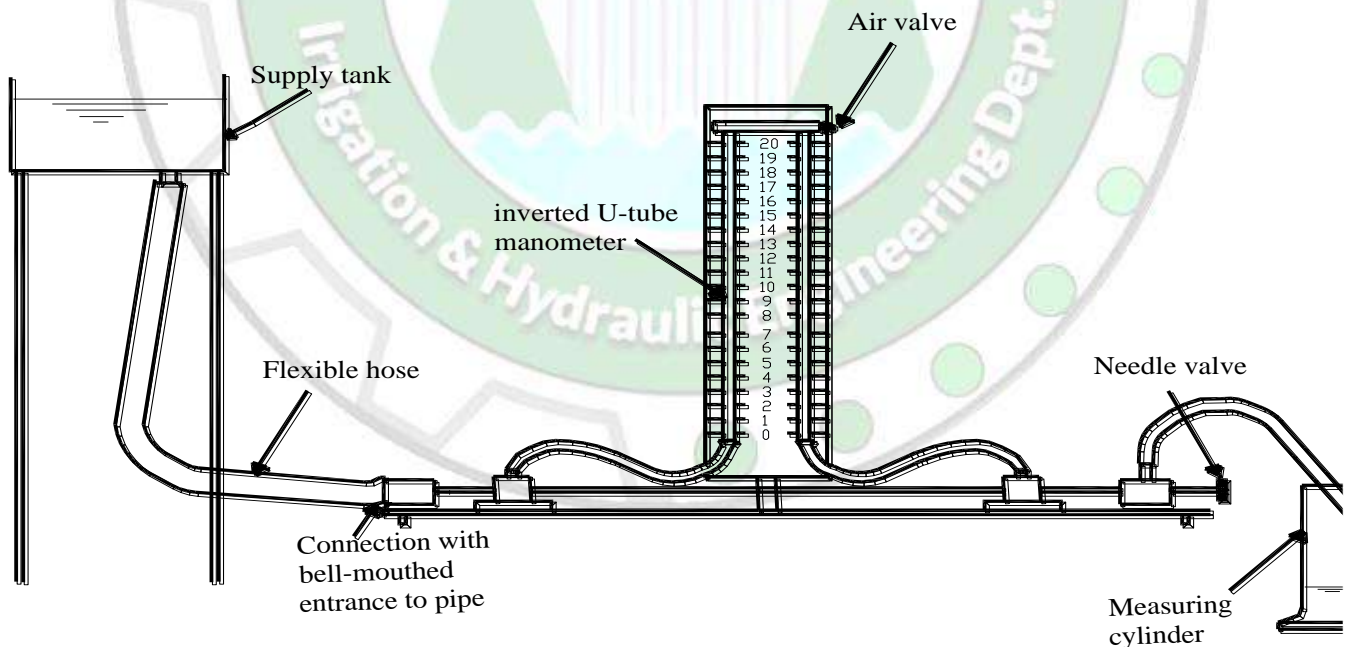
EXPERIMENT (4)

4.1. General Information

- Experiment name: *Friction Loss Along a Pipe and a Networks*
- Second year civil engineering
- First term

4.2. Apparatus Description

The following figure shows the arrangement in which water from a supply tank is led through a flexible hose to the bell-mouthed entrance to a straight tube along which the frictional loss is measured. Pizometer tappings are made at an upstream section which lies approximately 50 tube diameters away from the pipe entrance and at a downstream section which lies approximately 20 tube diameters away from the pipe exit. The rate of flow along the pipe is controlled by a needle valve at the pipe exit.



Arrangement of apparatus for measuring friction loss along a pipe

4.3. Theoretical Background

Studying the Hydraulic Losses in Energy for the following:

1-Rounded Bend

2-Sharp Bend 90°

3-Pipe Lines (PVC)

4-Gate valve and ball valve

5-Sudden expansion

6-Sudden Contraction

7-Four rounded Bends

8-For sharp Bends

At different values for flow rates (Q)

- The apparatus is set on the bench and leveled so that the manometers stand vertically and inverted u-tube manometer is connected to the pizometer. The supply tank is filled by a hose from the bench valve which may then be shut off. The needle valve is then closed whereupon the levels in the two limbs of the inverted u- tube should settle to the same value. The first reading of head loss and flow may now be taken. The needle valve is opened fully to obtain a differential head of at least 12 in and the collection of a suitable quantity of water in the measuring cylinder is timed. To obtain a rang of results in the turbulent region it is necessary to work with much greater differential heads than can be measured by the inverted u-tube manometer. It is desirable to take one or two

readings at the lower end of the rang which overlap the rang already covered by the water manometer. Since a reading of 1 in on the mercury u-tube corresponding 12.6 in on the water manometer this requires one or two readings in the region of 1 in. the diameter of the tube and the length between pizometer tapping should be noted.

- Length of pipe between pizometer tapings,
l.....20.7in
- Diameter of pipe, D.....0.116 in
- Cross sectional area of pipe, A.....1.057x10²
in²
- So that..... $u = \frac{Q}{30.48^3} \times \frac{1}{7.34 \times 10^{-5}}$

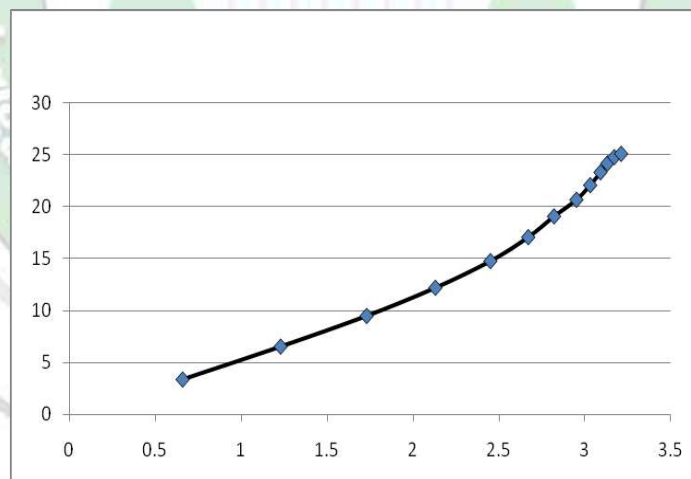
4.4. Steps of the Experiment

- 1- Operate the pump at different flow rate
- 2- Remove the air from the system
- 3- Take the manometers reading in table as shown
- 4- Repeat the table readings at different flow rates

4.5. Results

Q ty cc	t sec	u Ft/sec	h ₁ In	h ₂ in	i	θ °c	log l (-ve)	logu
400	56.6	3.4	16.6	2.83	.66	18.7	.1	.5
400	60.6	3.17	15.7	3.82	.57		.2	.5
400	65.2	2.95	14.9	4.78	.48	18.7	.3	.4
400	71	2.71	13.95	5.82	.39		.4	.4
300	56.2	2.57	13.23	6.57	.32		.5	.4
300	62.4	2.31	12.72	7.11	.27	18.7	.5	.3
300	72.8	1.98	12.3	7.68	.22		.6	.3
300	82.8	1.63	11.9	8.12	.18		.7	.2
300	101	1.43	11.66	8.39	.15	18.7	.8	.1
200	81	1.19	11.44	8.75	.13		.9	.1
200	117	.82	11.07	9.22	.08		1	.2
150	120	.6	10.84	9.47	.06	18.7	1	.5
100	148	.32	10.58	9.84	.03		1	.5

4.6. Discussion



Variation of hydraulic gradient i with velocity u along pipe

EXPERIMENT (5)

5.1. General Information

- Experiment name: Hydrostatic Pressures on Submerged Surfaces
- Second year civil engineering
- First term

5.2. Theoretical Background

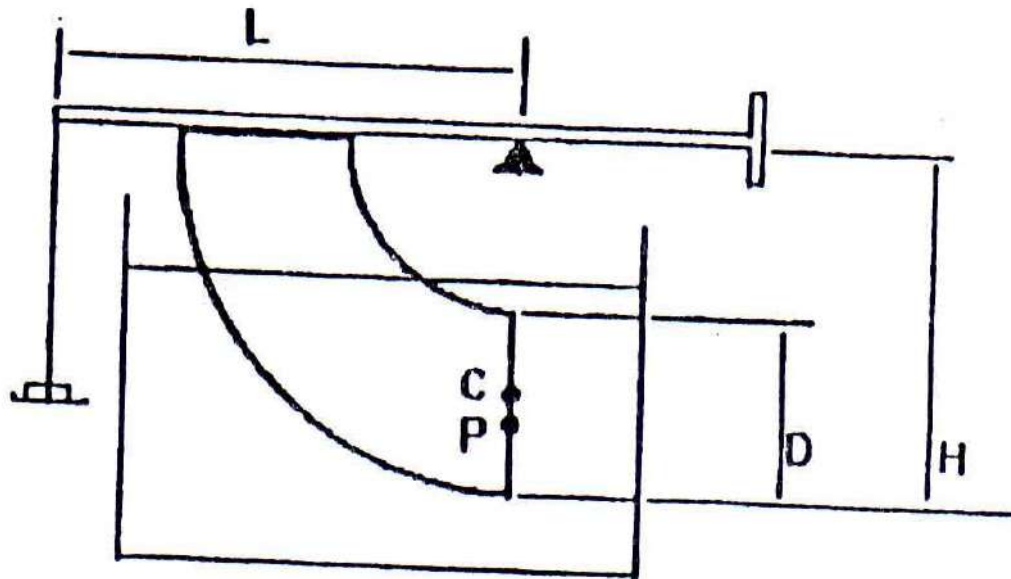
We consider a submerged surface in a stationary fluid. When a fluid is stationary, it has only normal stress, which is called pressure, but it has no shear stress. Hence, any submerged surface in a stationary fluid would experience hydrostatic force. Another characteristic of stationary fluid is that its free surface is always perpendicular to the direction of gravitational acceleration. What we need to determine here are the magnitude and location of the hydrostatic forces acting on the submerged surface of the torroid .The hydrostatic pressure p below the horizontal free surface is given by:

$$p = \gamma y + p_{atm}$$

where γ is the specific weight of the fluid, y is the vertical distance below the free surface, and p_{atm} is the atmospheric pressure which can be taken to be zero. The fluid pressure acts normal to the surface of an object and is positive in the direction into the surface. Integration of the pressure over a submerged surface yields the total hydrostatic pressure force acting on that surface. Similarly the resultant moment about a suitable specified point can be obtained by integrating the moments from the pressure over the body surface. Through total moment of momentum balance, the rotating part of the equipment is balanced with the load W on the scale.

5.3. Steps of the Experiment

- 1- Use the small weight and Put it in the balance.
- 2- Fill the system with water .
- 3- Read the value d against w at Horizontal level for the arm.
- 4- Repeat the Experiment by using Different weights .



The hydrostatic pressure of liquids is the “gravitational pressure” “Phyd”. It Rises due to the intrinsic Weight as the depth t increases, and is calculated from:

$$P_{\text{hyd}} = \rho \cdot g \cdot h$$

where:

ρ : Density of water

g : Acceleration due to gravity ($g = 9.81 \text{ m/s}^2$)

h : Distance from liquid surface to calculate forces acting on masonry dams or ships ‘hulls, for example, from the hydrostatic pressure, two steps are required:

حالة السطح الراسي	مستوى كلياً	مستوى جزئياً
<p>انحلال الرضوي</p>	<p>شكل (5)</p>	<p>شكل (4)</p>
$F =$ $F = \gamma BD \left(d - \frac{D}{2} \right)$	$F = \gamma BD \left(\frac{d^2}{2} \right)$	$F = \gamma BD \left(\frac{d^2}{2} \right)$

Surface condition	Fully Submerged	Partially Submerged
Experimental $h''_{exp} =$	$h''_{exp} = \frac{WL}{BD \left(d - \frac{D}{2} \right)}$	$h''_{exp} = \frac{WL}{F}$
$h''_{th} =$ Theoretical	$h''_{th} = \frac{\frac{D^2}{12} + \left(d - \frac{D}{2} \right)^2}{\left(d - \frac{D}{2} \right)} + H - d$	$h''_{th} = H - \frac{d}{3}$

5.4. Results

1- Draw the Relation between the Hydrostatic force (F) and the submergence depth (d)

2- Draw the Relation between ($h_{exp.}$) and ($h_{theo.}$)

Depth of immersion, d cm	Weight W (Kg)	Readings No
		1
		2
		3
		4
		5
		6
		7
		8

($h_{t h}$) cm	(h_{exp}) cm	Force F Kg	Depth of immersion, d	Weight W (Kg)	Readings No
					1
					2
					3
					4
					5
					6
					7
					8

5.5. General Questions

- 1) Why is the weight of the vessel and the beam not included in the expression for the center of gravity?
- 2) How would the location of the center of pressure change if a different fluid were used in the tank?

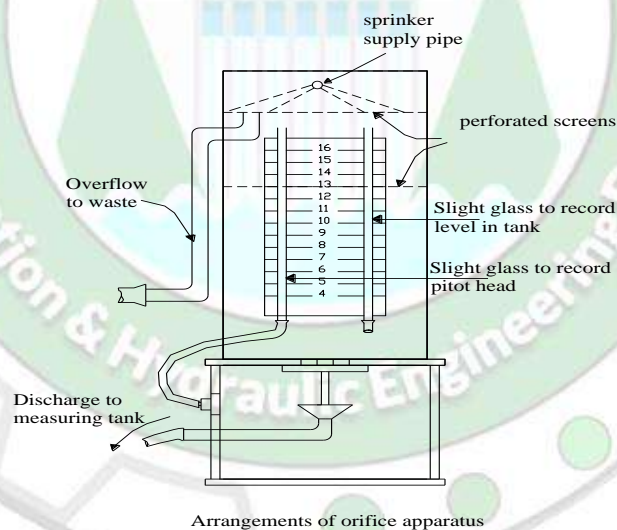
EXPERIMENT (6)

6.1. General Information

- Experiment name: Discharge Through an Orifice
- Second year civil engineering
- First term

6.2. Theoretical Background

The following figure shows the arrangement of the tank which is fed from the bench supply valve through a sprinkler pipe distributes the water over perforated screen. The water passes down the tank through a second screen which serves to stabilize the flow, and leaves through a sharp edged orifice which is fitted into the base of the tank in such a way that there is no unevenness along the inner surface.



6.3. Steps of the Experiment

The experiment may be divided into two parts, firstly, the measurement of C_d , C_u , and C_c at a single constant value of H_o , and, secondly, measurement of discharge at a number of different values of H_o . In the first part of the experiment, water is admitted to the tank to allow it to fill

to the height of the over flow pipe and the inflow is regulated so that a small steady discharge is obtained from the over flow. To measure C_u , the pitot tube is inserted into the emerging jet close to the underside of the tank, the values of H_c , and H_o are noted. To measure C_c it is necessary to find the diameter of the jet at the vena-contracta. In the second part of the experiment, the inflow to the tank is reduced to lower the level in the tank in stages, the discharge from the orifice being measured at each stage.

6.4. Results

Diameter of orifice = 0.497 in

Cross-sectional area, $a_o = 0.194 \text{ in}^2$

Head of orifice, $H_o = 14.86 \text{ in}$

Time required to collect 30 *lb* of water = 65.6 sec

Discharge , $Q = 0.00733 \text{ cusecs}$

Pitot tube reading, $H_c = 14.84 \text{ in}$

Diameter of jet = 0.391 in.

$$C_d = \frac{Q}{\sqrt{2gH_o a_o}}$$

$$C_d = \frac{0.00733}{\sqrt{64.4 \times 1.23 \times 0.001347}}$$

$$C_d = 0.61$$

$$\text{Coefficient of velocity, } C_u = \sqrt{\frac{H_c}{H_o}}$$

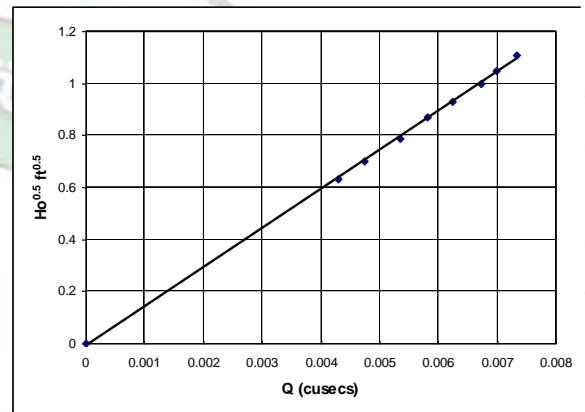
$C_u = 0.999$, say 1

Coefficient of contraction

$$C_d = \frac{a_c}{a_o}$$

$$C_c = 0.619$$

Qty.	t	H _o		Q	H _o ^{0.5}
		in	ft		
30	65.6	14.9	1.23	.00733	1.11
30	68.8	13.5	1.12	.00699	1.05
30	71.4	12.2	1.01	.00673	1.0
30	77.2	10.6	0.88	.00623	0.93
30	82.6	9.14	0.76	.00582	0.87
30	90.0	7.52	0.62	.00534	0.79
30	101.6	6.01	0.5	.00473	0.70
30	112	4.8	0.4	.00429	0.63



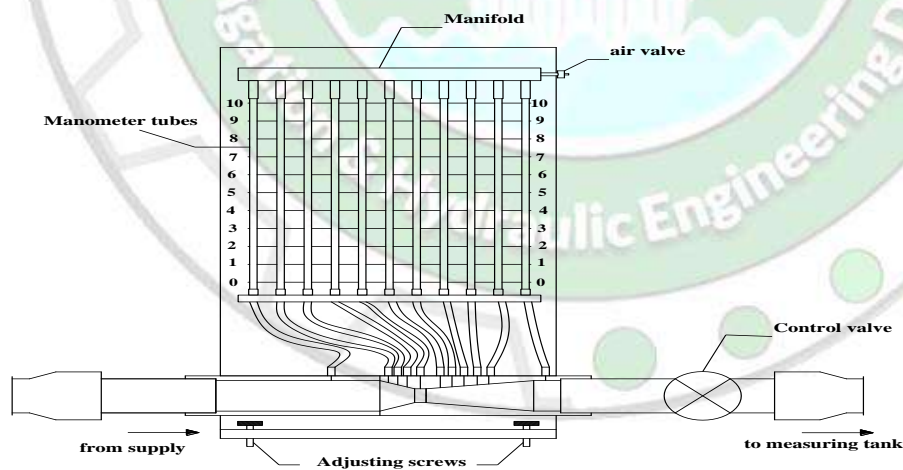
EXPERIMENT (7)

7.1. General Information

- Experiment name: Flow through a Venturi-meter
- Second year civil engineering
- First term

7.2. Theoretical Background

The following figure shows the arrangement of the venturi meter, which is manufactured in clear plastic material. Water is admitted from the bench supply valve and passes through a flexible hose into the meter. Beyond the control valve, which is just downstream the meter, a further flexible hose leads to the measuring tank. At a number of points along the length of the convergent-divergent passage of the venturi piezometer tubes are drilled into the wall and connections are made from each of these to vertical manometer tubes.



Arrangement of Venturi Meter Apparatus

7.3. Steps of the Experiment

The coefficient of the meter is to be estimated. It is necessary to obtain the variation of $(h_1 - h_2)$ with discharge, Q . Preliminary, the manometer

scale should be leveled. When the water level have risen to a convenient height, the bench valve is also gradually closed, so that the meter is left containing static water under moderate pressure. Measurements of a series of values of (h_1-h_2) and Q can be made. If difficulty is experienced in reaching a steady condition, air may be released from the manifold through the small valve at the end. The significant value of (h_1-h_2) is at the throat of the venture.

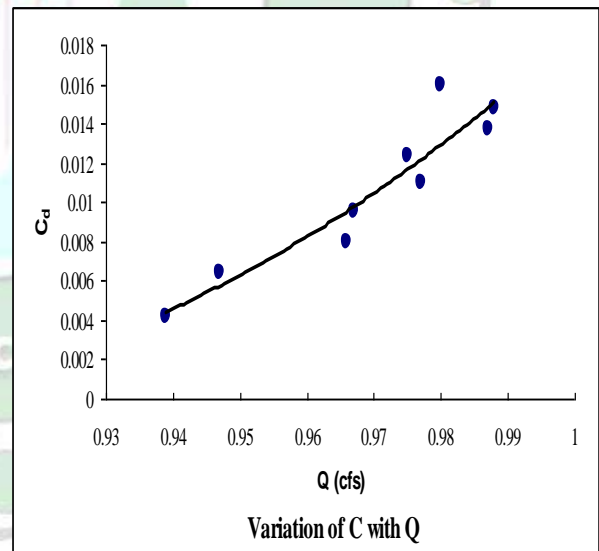
7.4. Results

The coefficient of the discharge, C_d , can be calculated from the equation:

$$Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2g(h_1 - h_2)}$$

a_1 is the inlet area, and a_2 is the area at the throat.

Q cfs	$(h_1-h_2)^{0.5}$ ft ^{0.5}	C_d
0.01592	0.876	0.980
0.01478	0.806	0.988
0.01368	0.747	0.987
0.01236	0.683	0.975
0.01098	0.606	0.977
0.00954	0.532	0.967
0.00801	0.447	0.966
0.00641	0.365	0.947
0.00420	0.241	0.939



EXPERIMENT (8)

8.1. General Information

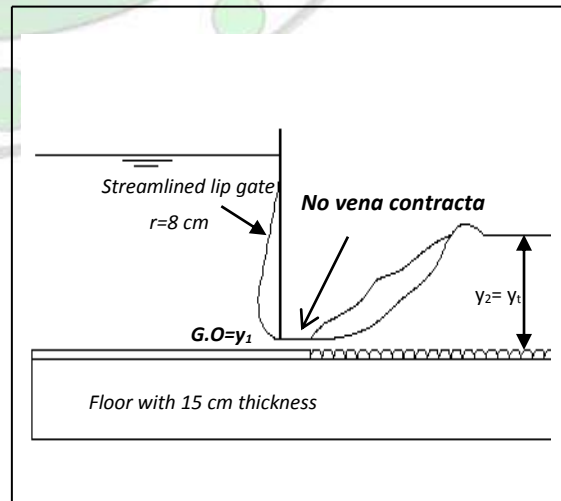
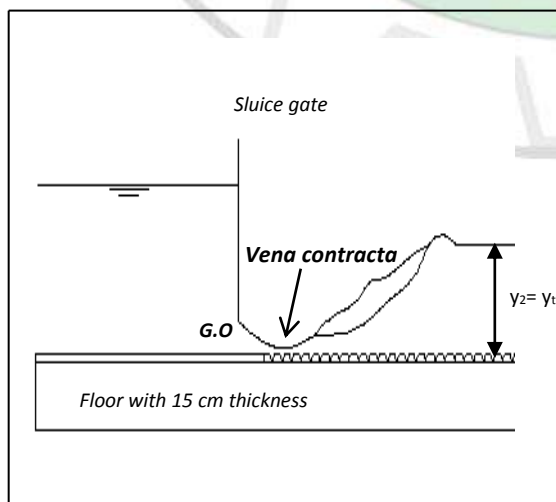
- Experiment name: Hydraulic jumps
- third year civil engineering
- First term

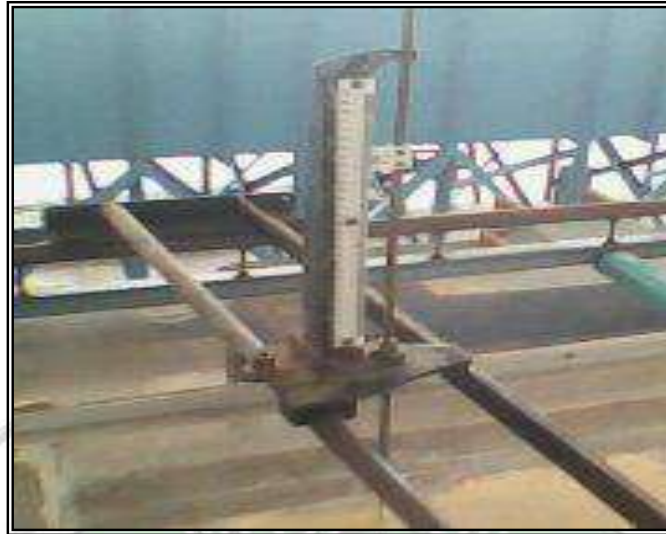
8.2. Required Apparatus for the Experiment

- * Laboratory channel
- * Gauge for measuring discharge



- * Sluice gate.

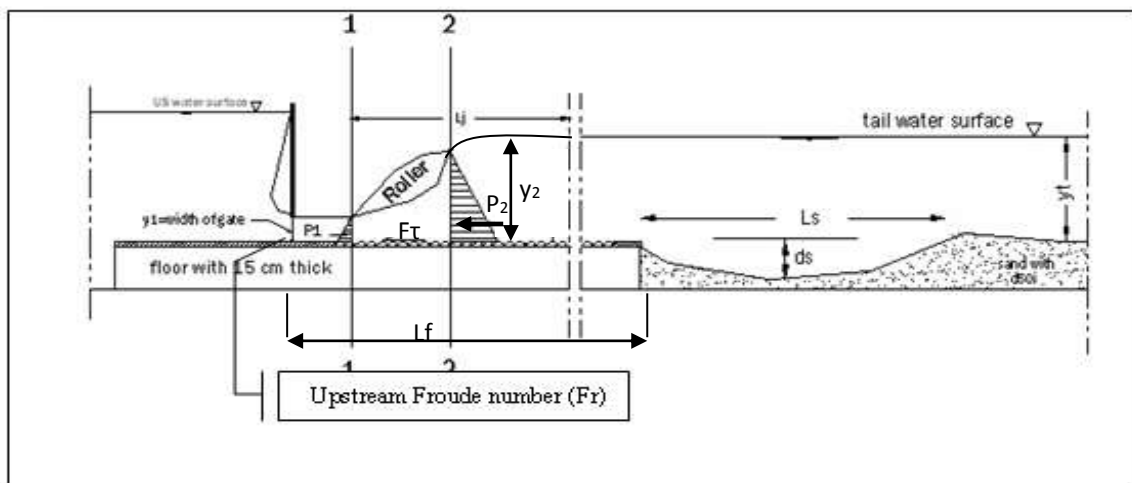




* Device for measuring velocity

8.3. Theoretical Background

The shear force acting on corrugated bed surface can be calculated by using momentum equation. The initial water depth and sequent depth of hydraulic jump can be obtained from experimental work then applying momentum equation between section (1) and section (2), figure (1).



Equation:

- the liquid is incompressible;
- the flow is steady;

- the pressure distribution is hydrostatic before and after the jump;
- the initial kinetic energy correction factor α , is unity; and
- the initial momentum coefficient β , is unity.

This equation of momentum could be written as:

$$P_1 - F_\tau - P_2 = \rho Q (V_2 - V_1) \dots\dots\dots (8.1)$$

where:

$$P_1 = \frac{1}{2} \gamma y_1^2 \quad \& \quad P_2 = \frac{1}{2} \gamma y_2^2 \quad \& \quad \rho = \frac{\gamma}{g} \quad \& \quad V_1 = \frac{q}{y_1} \quad \& \quad V_2 = \frac{q}{y_2} \quad \& \quad q = \frac{Q}{b}$$

in which:

- P_1 : hydrostatic pressure at section (1);
- P_2 : hydrostatic pressure at section (2);
- F_τ : shear force acting on bed surface;
- g : acceleration due to gravity;
- ρ : density of water;
- Q : flow passes under gate opening;
- q : flow per unit width;
- b : channel width;
- y_1 : initial water depth;
- y_2 : sequent depth of hydraulic jump;
- γ : specific weight of water;
- V_1 : velocity of water at section (1); and
- V_2 : velocity of water at section (2).

Substituting P_1 , P_2 , ρ , V_1 , V_2 and q in equation (1), then

$$\frac{1}{2} \gamma y_1^2 - \frac{1}{2} \gamma y_2^2 - F_\tau = \frac{\gamma}{g} q^2 \left(\frac{1}{y_2} - \frac{1}{y_1} \right) \dots\dots\dots (8.2)$$

From equation (2), the value of shear force acting on bed surface could be calculated by measuring initial and sequent depths of hydraulic jump and the discharge, equation (1) becomes;

$$F_{\tau} = \frac{1}{2} \gamma y_1^2 - \frac{1}{2} \gamma y_2^2 - \left[\frac{\gamma}{g} q^2 \left(\frac{1}{y_2} - \frac{1}{y_1} \right) \right] \dots\dots\dots (8.3)$$

8.4. Steps of the Experiment

* Calibration of discharge gauge

The flow meter is based on an internal moving device, which activates a mechanism attached to three indicator wheels and three dials:

- **First dial** each cycle of the moving pointer means passing a volume equal to 10 liters of water through the flow meter.
- **Second dial** each cycle of the moving pointer means passing a volume equal to 100 liters of water through the flow meter.
- **Third Dial**each cycle of the moving pointer means passing a volume equal to 1000 liters of water through the flow meter.

The measuring devices of discharge were calibrated. Table (1) gives measurements and results for the calibration processes. Figure (3) provides the actual discharge in lit. /sec. versus the flow meter discharge.

Table (1): Measurements of discharge for flow meter calibration

<i>The head tank method</i>			<i>The Flow Meter</i>			<i>%D*</i>
<i>Volume (Liters)</i>	<i>Time (Second)</i>	<i>Discharge (Lit. /sec)</i>	<i>Volume (Liters)</i>	<i>Time (Second)</i>	<i>Discharge (Lit. /sec.)</i>	
600	102	5.8823	607.1	106	5.727	+2.71
600	98	6.122	607.1	101	6.01	+1.86
600	66	9.09	607.1	68	8.93	+1.79
600	49.8	12.04	607.1	51.7	11.742	+2.53
600	47	12.76	607.1	48.8	12.44	+2.57
600	44.2	13.57	607.1	46.2	13.14	+3.27
600	41	14.63	607.1	43	14.118	+3.62
600	39.5	15.1	607.1	41.3	14.699	+2.72

- : *percentage difference between the head tank method and the flow meter reading*

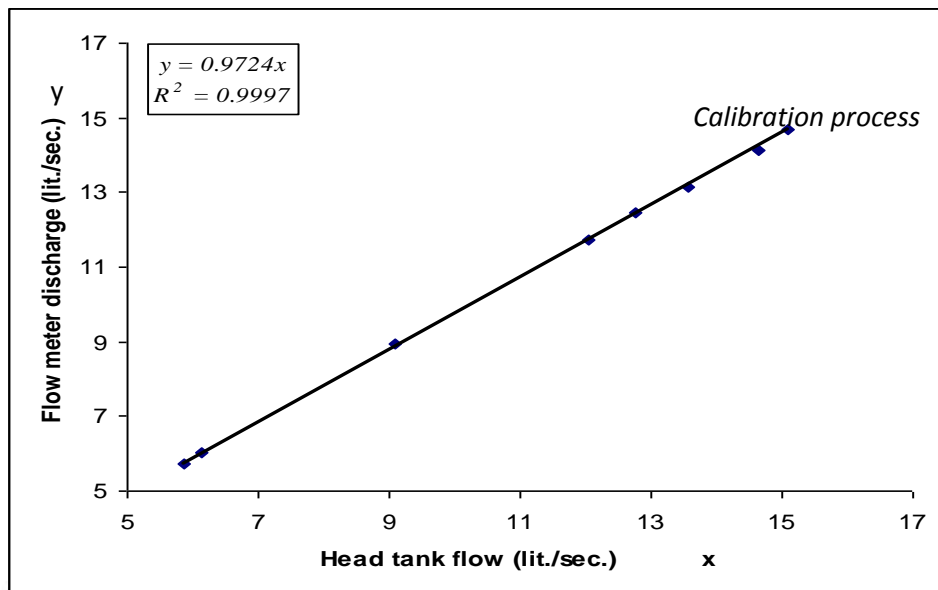


Figure (8.3): Calibration curve for the volumetric flow meter

The experiments were carried out using different models and with the three different beds to determine the following parameters:

- initial water depth on hydraulic jump (y_1) or the gate opening height (G.O);
- sequent depth of the jump (y_2);
- tail water depth (y_t);
- length of hydraulic jump (L_j);
- required time for settling the scour operation (T);
- maximum scour depth (d_s);
- maximum length of scour hole (L_s); and
- depths of the scour at selected points at the downstream sections.

Fifteen runs were carried out for every shape of corrugations with a discharge ranged from 5.0 to 15.0 lit. /sec. These runs were repeated with

the three sand samples, at $d_{50} = 0.62$ mm (coarse), $d_{50} = 0.365$ mm (medium) and $d_{50} = 0.167$ mm (fine). The total number of the experimental runs was 285 runs.

a) Experimental Set up

- 1- The level of sand surface is kept at the same level of the crests of the corrugated bed.
- 2- The level of floor upstream gate is prepared to be at the same level of the crests of corrugations, plate (1).
- 3- The corrugations in the floor bed start downstream a streamlined lip gate by 15 cm.
- 4- A streamlined lip gate is prepared to tackle the effect of *vena contracta*.
- 5- The regulated valve in the supply line is opened to give the required discharge.



Plate (1): Crests of corrugations are at the same level of the upstream bed

b) Experimental Procedure

- 1- A steady flow of water is established through all experiments.
- 2- The tail gate is adjusted to ensure the formation of hydraulic jump.
- 3- The discharge is measured using flow meter and stop watch.
- 4- The gate opening is considered to be the initial depth of jump and the point gauge used to measure the sequent depth of jump (y_2), the length of jump is measured by ordinary scale.
- 5- The time used for making the scour hole at balance state is measured using stop watch.
- 6- The maximum depth of scour and the corresponding length are measured.
- 7- The point gauge is used to measure the depth of scour at any point for drawing the scour contour lines.
- 8- After completion of the experiment, another model of corrugated bed is placed in the flume over the timber floor and the experiment is repeated.

8.5. Results

Plates (1) and (2) show an oscillating jump ($Fr=4.26$) and steady jump ($Fr=5.6$) over triangular corrugated bed.



Plate (1): An oscillating jump ($Fr=4.26$) over triangular corrugated bed



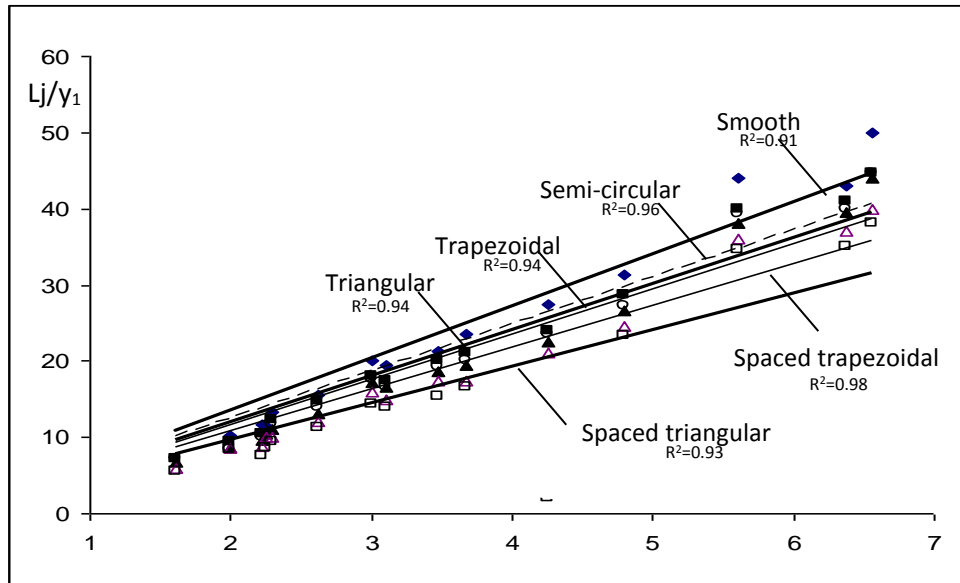
Plate (2): Steady jump ($Fr=5.6$) over triangular corrugated bed

8.6. Analysis

It is noticed that the length of jump over semi-circular, trapezoidal, triangular, spaced trapezoidal and spaced triangular corrugated beds at 15 lit. /sec., is less than the corresponding length over smooth bed by about 13.42%, 13.71%, 14.28%, 20% and 25.7% respectively, and it is less than the corresponding length over smooth bed at 8 lit. /sec., for these beds by about 5.0%, 9.75%, 10%, 14.75% and 18.75% respectively.

It is observed that the value of jump length by using a discharge of 15 lit. /sec., is greater than the corresponding value for all used discharges together (from 8 lit. /sec. to 15 lit. /sec.), by about 1.2% for spaced triangular bed and by about 4.42% for semi-circular bed. At a discharge of 8 lit. /sec. the jump length is less than the corresponding length, for semi-circular and spaced triangular bed by 4% and 5.72% respectively. This means that it is important to use more than one discharge for fitting the experimental data.

The length of jump (L_j) could be found in terms of, the initial depth (y_1), the sequent depth (y_2) or the difference between two conjugate depths ($y_2 - y_1$). The plot of Fr versus L_j/y_1 , is probably the best as the resulting curve can be best defined by the experimental data. For practical purposes, however, the plot of Fr versus L_j/y_2 , is desirable because the resulting curves show a flat portion for the range of well established jump (Chow, 1959).





الخدمات البحثية

EXPERIMENT (1)

Title: Improvement of Breakwaters Efficiency

By: Mohammed el-sharabassy.

Objectives : Determine the efficiency of Breakwaters.

Used Facilities :

Wave generator flume with horizontal and vertical scales was used in this test. The models of breakwaters were used too.





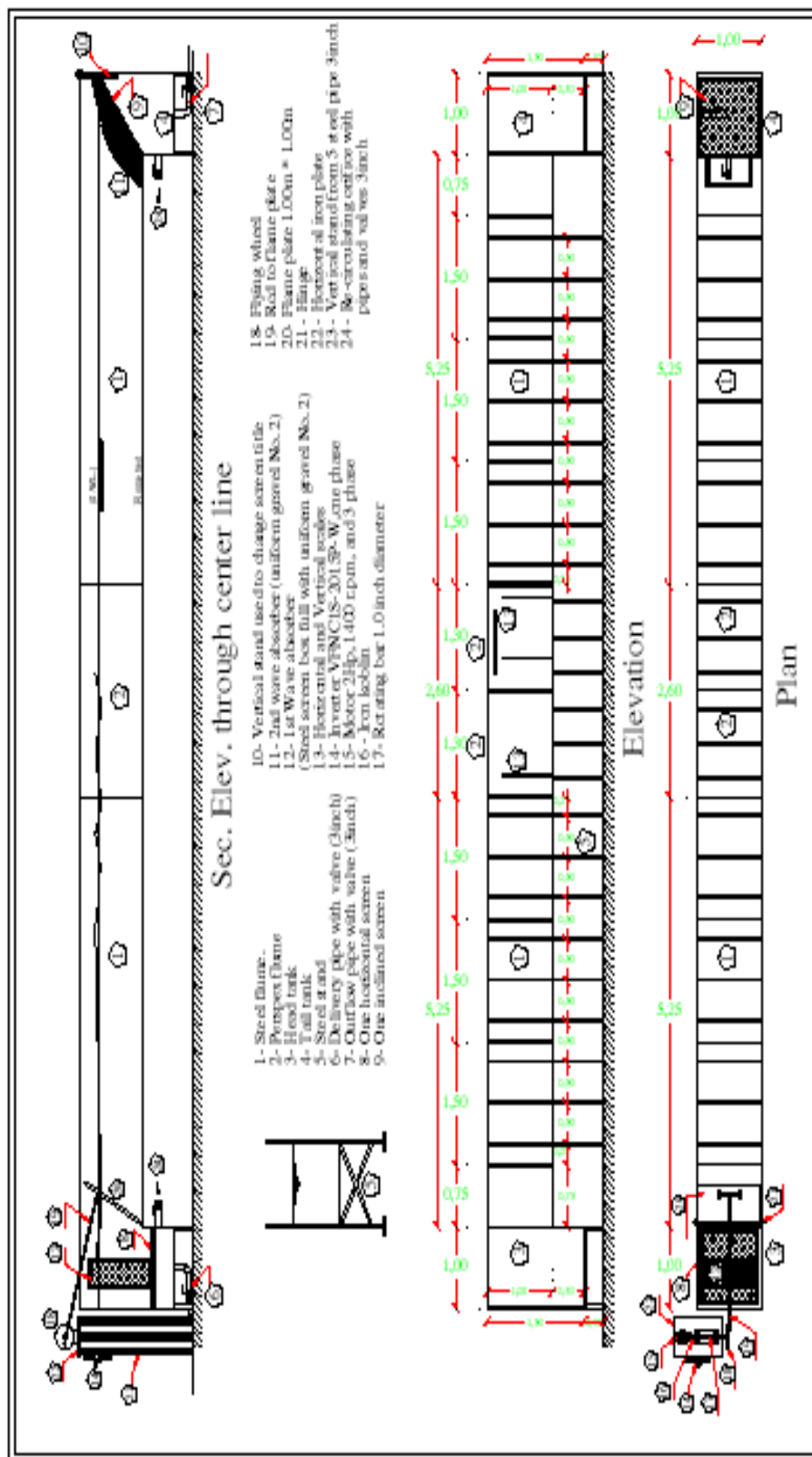


Figure (4.1): The Wave Flume Views

• الأساس النظري للتجربة:

H_{max} = Max. Wave Height = Max. Crest Level – Min. Trough Level

H_{min} = Min. Wave Height = Min. Crest Level – Max. Trough Level

H_i = Incident Wave Height = $0.50 (H_{max} + H_{min})$

H_r = Reflected Wave Height = $0.50 (H_{max} - H_{min})$

H_t = Transmitted Wave Height = Max. Crest Level – Min. Trough Level

• خطوات تنفيذ التجربة:

During the experimental work, two measuring points at a distance $L/4$ and $L/2$ seaward the model face were chosen to determine the incident and the reflected wave heights. These two points were assumed to meet maximum and minimum of a standing wave envelope. Transmitted wave was determined by averaging the resulted heights recoded shoreward the model. The following procedure was followed throughout the runs:

1. The flume was filled to the selected depth ($d = 40$ cm) which is remains constant during all experiments.
2. Adjusting the eccentricity of the flying wheel to the chosen position in order to give the first wave condition.
3. The inverter frequency was adjusted to first wave period (T), from which the wave length (L) was calculated as shown previously.

4. The generator was turned on, and the wave surface variation was recorded at distance $(L / 2)$,and $(L / 4)$.
6. By observation and scaled tape, the crest and the trough elevations were measured.
7. from previous works, the following relationships was used to determine the incident and reflected wave heights:

$$H_{max} = \text{Max. Wave Height} = \text{Max. Crest Level} - \text{Min. Trough Level}$$

$$H_{min} = \text{Min. Wave Height} = \text{Min. Crest Level} - \text{Max. Trough Level}$$

$$H_i = \text{Incident Wave Height} = 0.50 (H_{max} + H_{min})$$

$$H_r = \text{Reflected Wave Height} = 0.50 (H_{max} - H_{min})$$

8. The transmitted wave was determined by averaging the recorded wave heights shoreward the model at each run from the relationship:

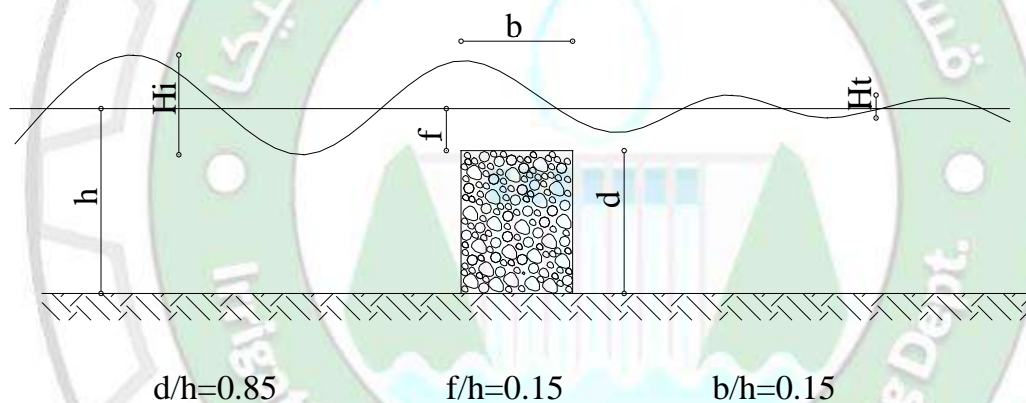
$$H_t = \text{Transmitted Wave Height} = \text{Max. Crest Level} - \text{Min. Trough Level}$$

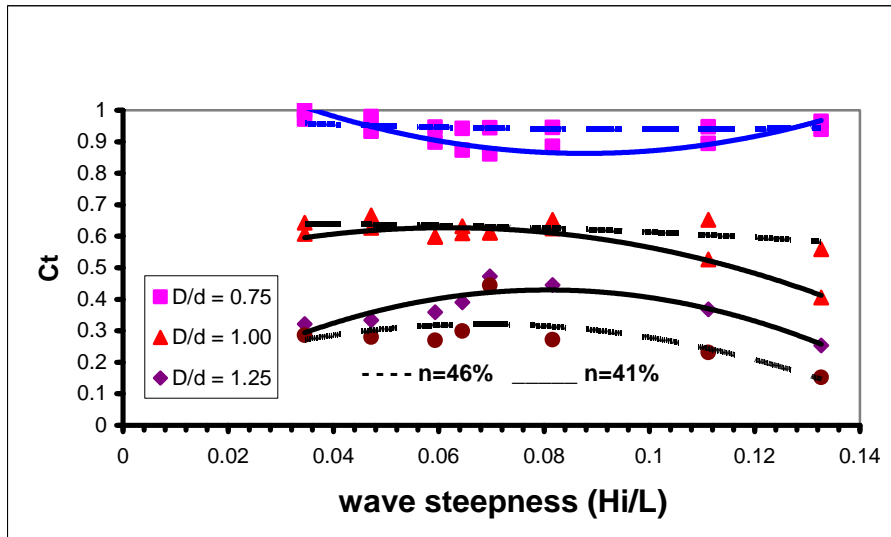
9. The previous steps were repeated with different eccentricities and frequencies to test different wave conditions

• النتائج:

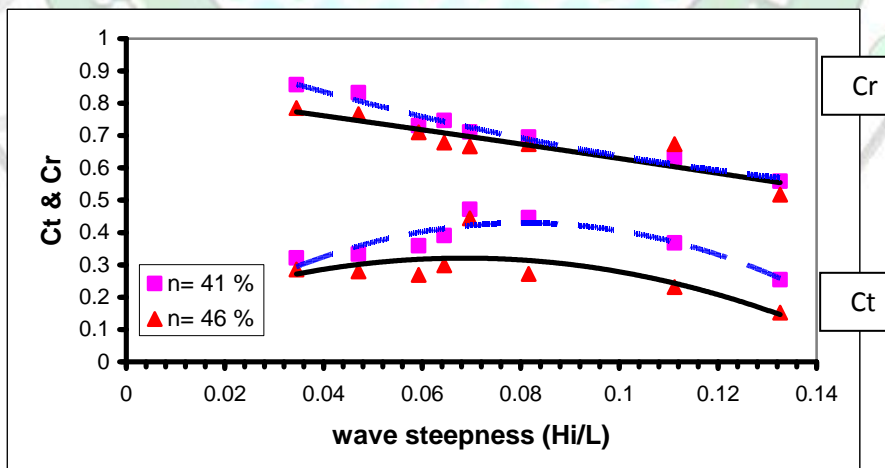
The arrangements of the model were classified according to the width of the wall, its porosity, and the height of the wall. After this we test each one under various wave conditions.

- Constant water depth (d) of 40 cm and three different values of wall width ($B = 12.0, 18.00, \text{ and } 24.00 \text{ cm}$) were used to test the change of the ratio B/d ($B/d = 30\%, 45\%, \text{ and } 60\%$) respectively.
- For the same width of the wall the height is change with (30, 40, 50) to test change of the ratio D/d ($D/d = 75\%, 100\%, 125\%$).
- For each of the previous cases, the porosity is change.

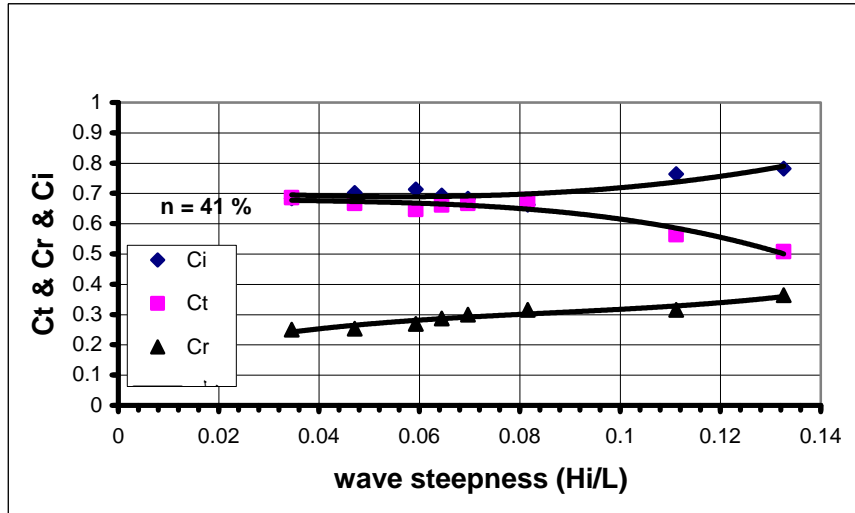




Relationship between H_i/L and C_t for different values of (D/d) .
($W/d = 0.30$)



Relationship between H_i/L and C_r, C_t for different values of porosity (n).
($W/d = 0.30, D/d = 1.25$)



Variation of C_r , C_t and C_i with H_i/L
 ($W/d = 0.45$, $D/d = 1.00$)

مناقشة النتائج:

1. The transmission wave coefficient for high porosity is greater than the corresponding value in the low porosity.
2. The efficiency of the breakwater increases when the wave condition changes from long to short waves.
3. The ratio between wall height and water depth D/d have strongly effect on C_t and C_r . While C_t decreases and C_r increases with the decreasing of D/d ratio from 0.00 to 1.25
4. The transmission wave coefficient, C_t decreases from about 0.35 to 0.1 as the width of wall increases from (0.30 – 0.60)d. On the other hand, the reflection coefficient, C_r increases under the same conditions.

5. When the wave number k_d increased (i.e. go to deep water zones), the value of C_t decreases and the values of C_r increases, which indicates that the suggested permeable breakwater has a highly efficiency in deep water zone than shallow water zone.
8. The results showed that there is energy loss in the incident wave and it was expressed as losses coefficient equal to $C_i = \nu (1 - C_r - C_t)$.

أسئلة عامة:

1- ما أهمية تطبيق هذه التجربة في الحياة العملية؟

قياس كفاءة حواجز الامواج المختلفة واستخدام الافضل للمنطقة تحت الدراسة.

2- هل يمكن استخدام التجربة لانواع اخري من حواجز الامواج؟

نعم, يمكن استخدام القناة لمعظم انواع حواجز الامواج.

EXPERIMENT (2)

Title: Improvement of Submerged Breakwater Efficiency

By: Mahmoud Ibrahim Saad Ibrahim Khalil

Objectives : Determine the efficiency of submerged breakwater alone and its efficiency with screen breakwater.

Used Facilities :

1. Wave Flume

Flume having 15.10 m length, 1.00 m width and 1.00 m depth used in research. Its rigid steel bed raises 1.16 m from the laboratory ground level. The total length of the flume consists of head tank 1.00 m long, an approaching steel part 10.5 m long, working section made from perspex 2.6 m long, and the tail tank 1.00 m long.



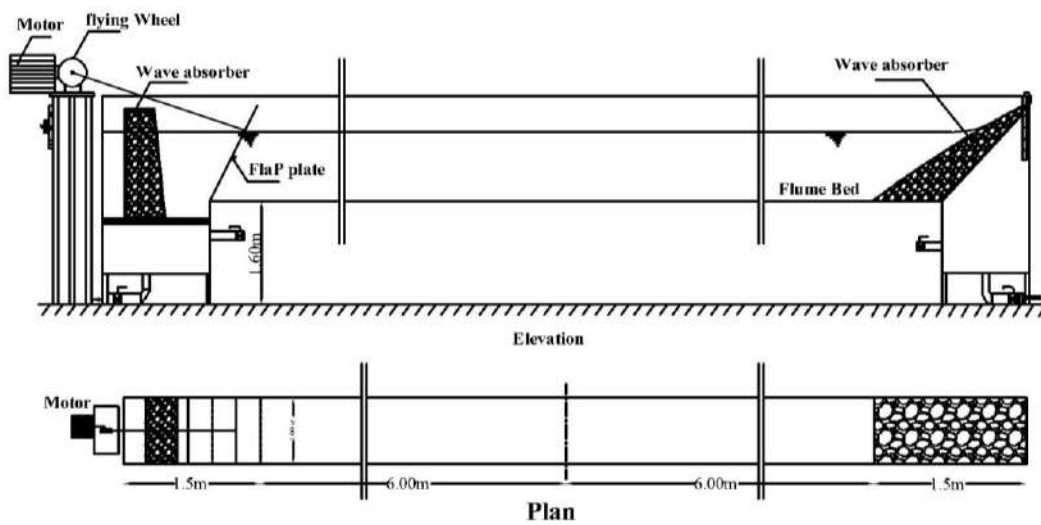
The flume is equipped with a variable speed flap type wave generator and a porous screen filled with uniform gravel at one end of the flume.



The other end contains a wave absorber in the form of a porous beach.



The details and dimensions of the flume are shown in figure (4.1).

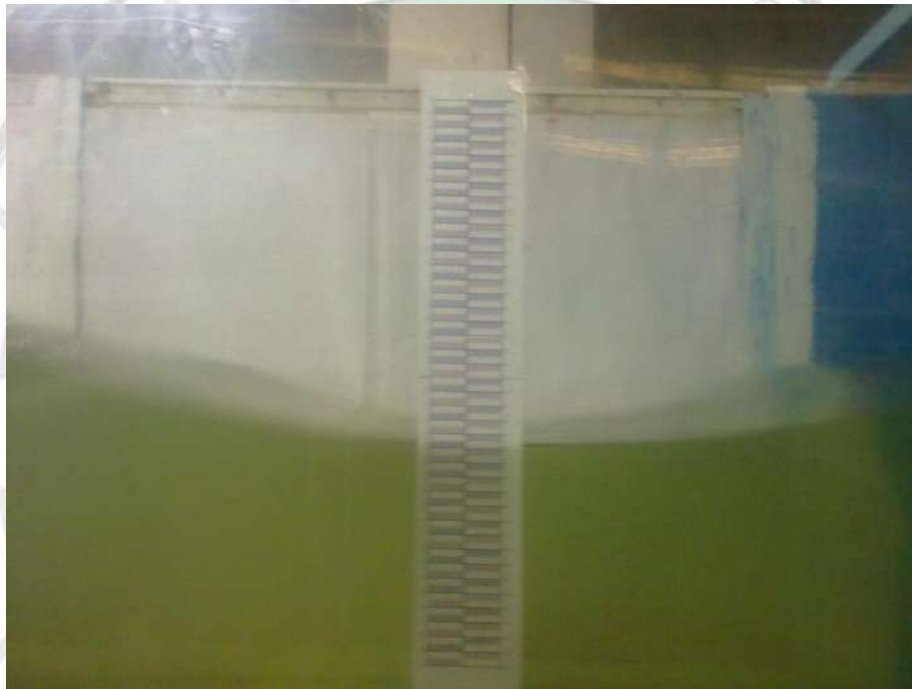


2. Measuring Devices

Vertical scales fixed with the perspex part are used to measure the wave height characteristics (H_i and H_t).

The vertical scales are positioned at Lee ward side of model.

A digital camera is used for recording the wave characteristics.



3. Testes Model :

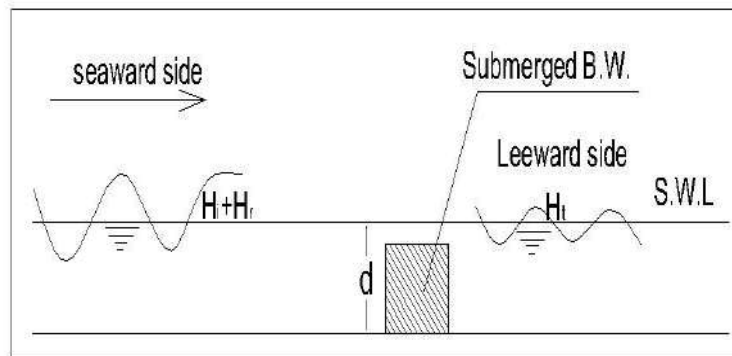


Figure (1) Tested Submerged Breakwater

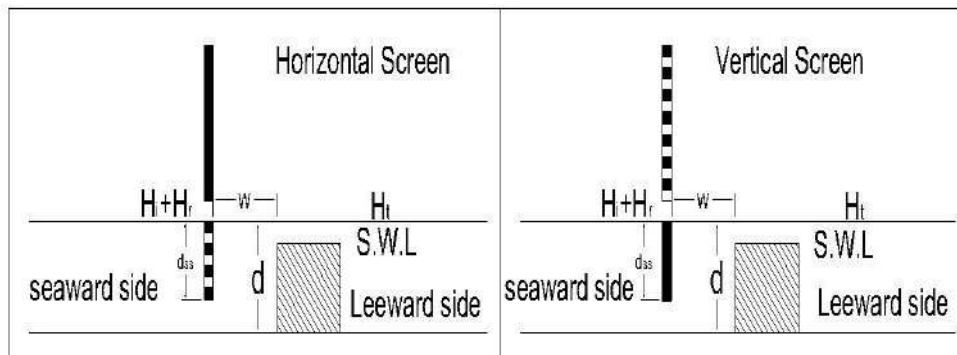


Figure (2) Submerged Breakwater with Single screen B.W.

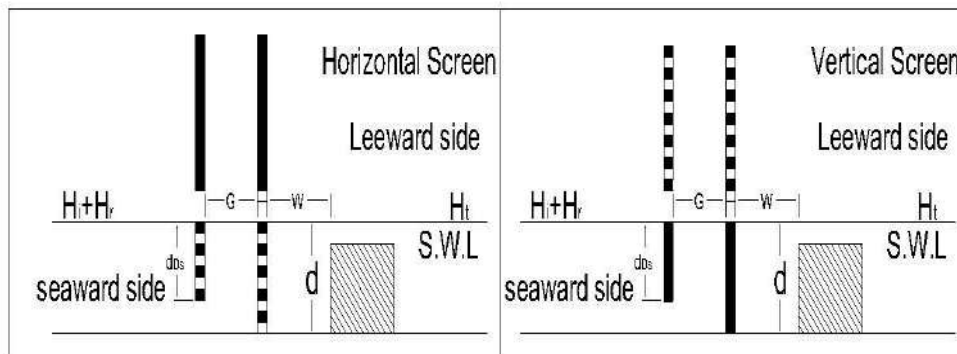


Figure (3) Submerged Breakwater with Double screen B.W.

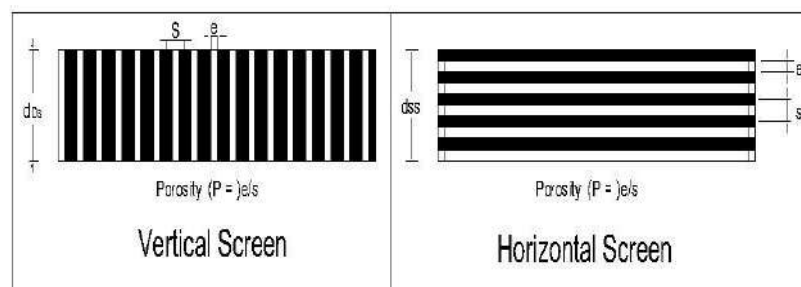


Figure (4) wave screen

EXPERIMENT (3)

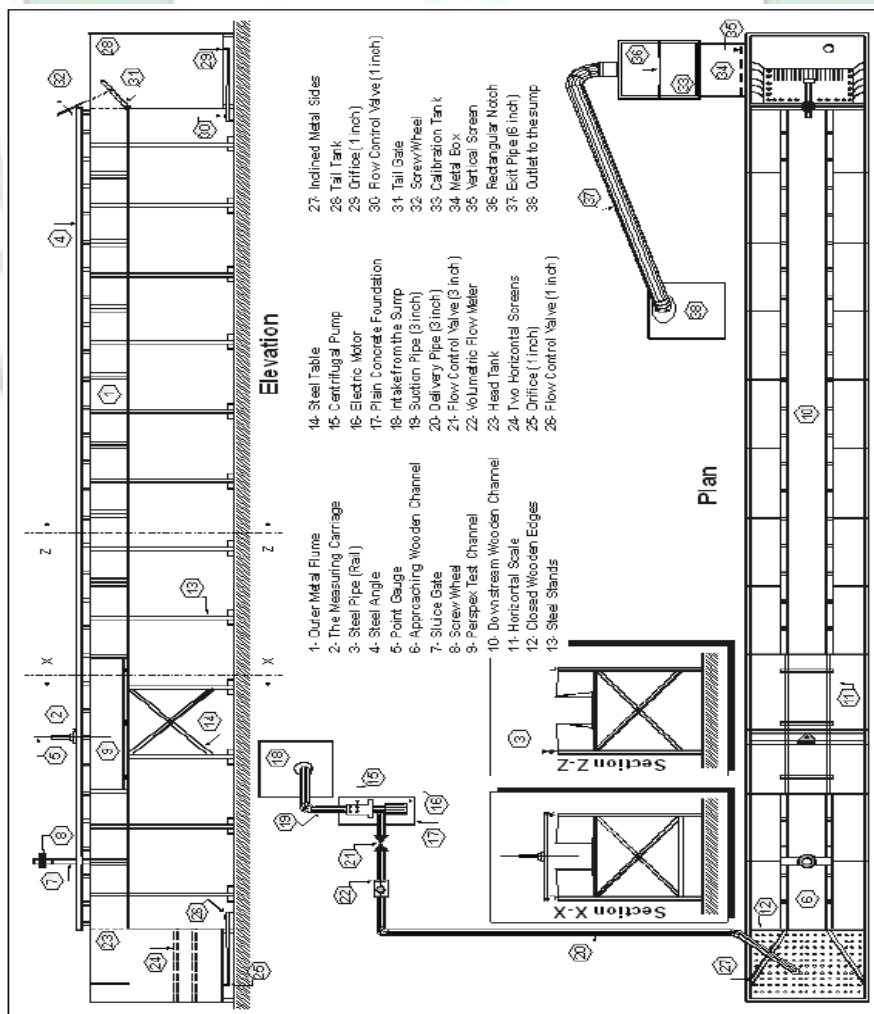
Title: The Role of Harmonic Mean Distance for Velocity Distribution in Open Channels.

By: Mahmoud el-Ashry.

Objectives : The verification of harmonic velocity distribution model using micro ADV.

Used Facilities :

From the most used instruments, we choose the 12m open channel flume, which had been set up for several configurations for several post graduate studies, figure #. One of these is: the verification of harmonic velocity distribution model using micro ADV, (part of the master of science thesis named "The Role of Harmonic Mean Distance for Velocity Distribution in Open Channels" M. el-Ashry).



Instruments and configurations:

12m open channel laboratory flume: Water is conveyed through the inner part of the flume, which is a wooden channel. A perspex sides and bed of 2m long are installed at 2m from inlet. The rest of the wooden channel is lined with smooth steel. Two section configurations were set up: (a) smooth section 40×30.5cm; and (b) smooth bed with rough sides 38×27cm, figure #. Water is supplied by a 10hp centrifugal pump at 15.5 lit/sec for the first configuration and 14.3 lit/sec for the second one. The tail gate is adjusted to give the required wetted cross section. For the two configurations, $Fr < 0.2$, and $Re \approx 15500$. The flow rate is measured by a turbine-type volumetric flow meter, which is bolted with two flanges in the supply pipeline. All velocity profiles were collected at the section of best velocity profile development.



16-MHz SonTek micro ADV (Acoustic Doppler Velocimeter): This is a single-point current meter that accurately measures the three components of water velocity in both high and low flow conditions. Velocities are measured in a sampling volume located at a distance away from the probe head, [HorizonADV manual, 2007]. Components: a) Signal Processing Hardware, figure #; and b) Micro ADV Probe, figure #.

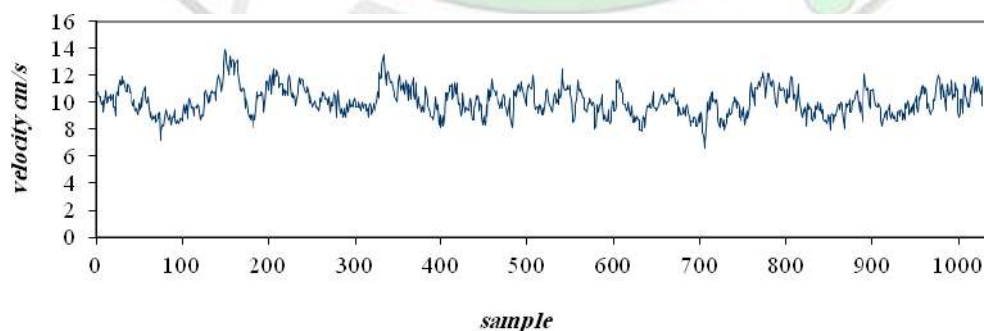


ADV theory of Work: The probe head is composed of a transmitter located in the center of the probe head, and three receivers mounted on arms, picture 5.4. The transmitter generates a narrow beam of sound that is projected through the water. Sound waves arrive at the measuring point and are reflected by particles and scatters in water to the receivers. The difference in frequency between the emitted and the received waves (Doppler-shift frequency) allows the calculation of the 3D water velocity.

ADV Probe Configuration: Through the software "Horizon-WinADV" some parameters are required to be fed by user. Table 5.2 shows the probe configuration loaded in the present work. Temperature and salinity slightly affect the speed of sound and are estimated reasonably.

Sampling rate	10Hz
Lag adjustment	enabled
Recording mode	Continuous
Temperature	22° C
Salinity	0 ppm

Each single measurement of velocity at a point is taken as the mean value of a velocity-time series of 70sec on the minimum. A time of 1min on the minimum is taken between each two sequent measurements, in order to minimize the error that might occur due to the disturbance of moving the instrument. Diagram # is a velocity sample from the present measurements.

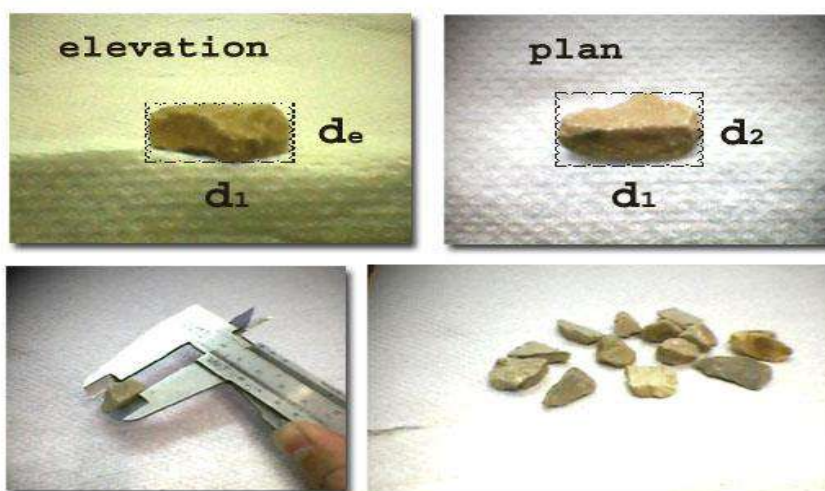


Set Up:

For each mentioned cross section, comparisons between measured velocity profiles and computed velocity profiles using the proposed model are introduced here. Each profile is followed by a diagram of errors, [error = (calculated – measured) / measured]. The average value of the absolute error is calculated for each profile as a percentage. Velocity of points at water surface is measured by calculating the time taken by a tiny floating body to cross a certain distance, analyzed by video.

Smooth configuration: For this configuration, the section bed and sides are made of smooth steel sheets with wetted dimensions of 40×30.5cm and a discharge of 15.5lit/sec. The surface roughness, K is 0.0001m.

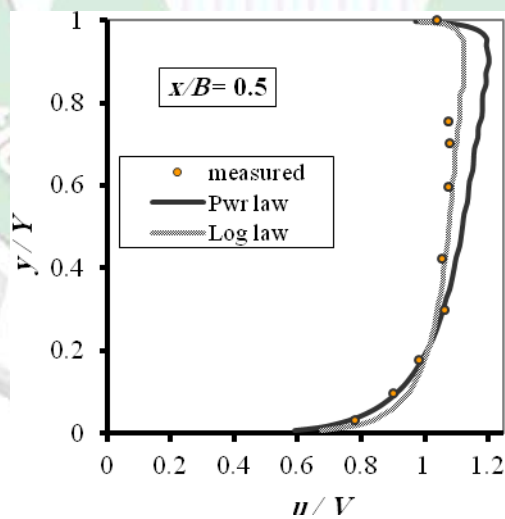
Rough configuration: For this configuration, the section bed is left on its original of smooth steel. K of bed is introduced by 0.00025m according to equation 3.10. Sheets of fabricated roughness of $K = 7\text{mm}$ are adhered to sides. The wetted section dimensions after installation are 38×27cm. The width 38cm is measured from the center of roughness height. Stones used in roughness were retained on 9mm sieve. The effective diameter, d_e , was measured for a representative sample and found to have an average of about 7mm. d_e is the vertical height of the stone when it is left to rest on a horizontal plane, picture #. Stones then were washed carefully and left to dry, then adhered to thin wooden sheets using a strong adhesive polymer, picture #.



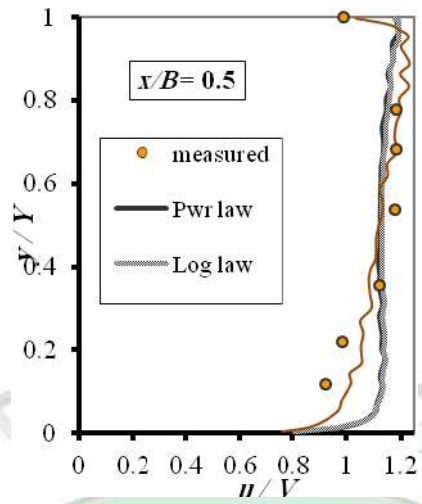


General Results:

In most cases, the proposed model showed good agreement with measured velocity profiles. Here we present a sample of result in both cases of configuration.



Comparison between computed vertical velocity profiles and measured profile along center line, [smooth configuration]



Comparison between computed vertical velocity profiles at $x/B = 0.5$,

