ƹ Ƭdž ƕDŽƽǁƐ ăP ƕʒþΘdžDŽǁƐǋ ƕĭơNjDŽyǁƐ ƕƨƯƑƩǁƐ ơNjơƨǂǁ ƹĭþƬǂǁƐ üDŽƑyDŽ ƕĭþƏƐơǁƐ

ĂǁNjDŽǁƐ DŽƑDŽĭǂƨ þƨyǀ ɳǁƑƬ ăNjFĭΘ ơĭǀǀDŽǁƐ ơǤƳ ƀƑdžlj

ŧöƑǤdž!ƒ þƧƒĂdž!ƒ ŧƪþljNj DŽƪp -ŧƪþljnj!ƒ ŧöǁǂ -ýƮĂdž!ƒ ŧzdžǤɳ

ƫ ơǂDŽǁƐ

ŧùöƧƒƒþ!ƒ 2Ʈùlj ŧdžl!ƒ ĭŖ ŧ5Ƨơljdž!ƒĂ ŧöþĂdžz!ƒ ŧƪƱǤʒ!ƒ þĂþƪl!! 2öƧƮk!ƒ ýdžǤzdž ŧƪƒƧþ Ƙdžk ýödžǤùɳdž Σùdžƿ Ĭùǁƶ Ƙdžƪþǖɳ ŖĂdžlj(45) ƒ ơ5Ă ǤƬlj ǃk Ŗ.ǤöƧƕkƿdž Ƨơ!ƒ LJǤöƧɳ!ƒ ƘǙǤơ Ƙơk ŧùƶĂdžɳdž!ƒĂ (θ=90°) Ĭù!ĂǕƒ ŧùƶĂdžɳdž!ƒ] θ lǤùlj!!ƒ ƧƒþùɳyDž ǤnjƼƒƧơljƒ ŧöĂƒƨ Ĭǁƶ þǤdžkƶǕǤƕ ŧùƶĂdžɳdž!ƒĂ (θ=30°) ŧùzƕƒƧ!ƒ ŧùƶĂdžɳdž!ƒĂ (θ=45°) ŧùƛ!Ǥƛ!ƒ ŧùƶĂdžɳdž!ƒĂ (θ=60°)ŧöljǤƛ!ƒ ŧǁƪǁƪ!ƒ βǤNjƧƿdž ýödž Ĭǁƶ þǤdžkƶǕǤƕ ýƪǖƪ ŧƛǖƛ Ĭǁƶ ŧdžƪldž ŧƶĂdžɳdž ýǂĂ [(θ =25°)ŧƪdžǤƿ!ƒ ýùödž Ƙùƕǀ Ă [(β=45°) C ŧƛ!Ǥƛ!ƒ ŧǁƪǁƪ!ƒĂ (β=60°) B ŧöljǤƛ!ƒ ŧǁƪǁƪ!ƒĂ (β=75°) A Ĭ!ĂǕƒ ƘƒƧùùdž ŧǖùƛ ǤùnjƶǤƼkƧƒ ƧùööʒkĂ DŽùƪ[R= 5]ŧdžl!ƒ ƧƱp 2ƮljĂ [α=75°] ŧ5Ǥǂ ǀŖǤdžlj!ƒ DŽþldž .DŽƪ [P=30,20,10]

ƽdžƶ ŧƕƪlj lþǤöƨƕ þƒþƨö ĭþĂdžz!ƒ ΣƱǤʒ!ƒ þƪl!! (Cd) 2öƧƮk!ƒ ýdžǤzdž LJD Ĭ!ǫ ŧƪƒƧþ!ƒ ǋƑǤklj ƘƧǤƬD ǤùnjzödžɳǀŖǤùdžlj!!ƧƿdĂ!ƒ ýùödž lþǤöƨƕĂ Ü(H/P) ĭþĂdžz!ƒ ΣƱǤʒ!ƒ þƪ!ƒ YǤƼkƧƒ Ĭ!ǫ þƪ!ƒ ŧdžp ƽĂ5 Ǥǂdž!ƒ ǤùNjƧƿdž ýùödž Ǒùk!ƒ ŧùǁöǁ!ƒ ƘǤùƶǤƼkƧǕƒ Ƙƒƙ ŧùöþĂdžz!ƒ ŧƪƱǤʒ!ƒ þĂþƪ!ƒ LJǫ.ŧ5Ǥǂ ƘǤƶǤƼkƧǕƒĂ ǑùƼĂ.DŽƪ(P=20,30) ŧö!Ǥz!ƒ ƘǤƶǤƼkƧǕƒ Ƙƒƙ ǤnjkǖöĂdž LJdž 2öƧƮk!ƒ ýdžǤzdž! ĬǁƶD ǤdžöpǑƱzk(β=75°) þƪù!ƒ YǤùƼkƧƒ Ĭ!ǫ Ǥǂdž!ƒ ƽdžƶ ŧƕƪlj lþǤöƨƕ ýlö 2öƧƮk!ƒ ýdžǤzdž LJǤ5 ŧ5Ƨơljdž!ƒ ŧƪƱǤʒ!ƒ þĂþƪ!ƒ ŧ!Ǥơ ýùödž lþǤùöƨƕ 2öƧƮk!ƒ ýdžǤzdž þƒþƨöĂ .ŧ5Ǥǂ ƘǤƶǤƼkƧǖ!Ă ǤnjzödžɳǀŖǤdžlj!! (H/P)2Ƨơljdž!ƒ ΣƱǤʒ!ƒ ƧƿdĂ!ƒ þƪ!ƒ ƧƿdĂ ΣƱǤʒ!ƒ ƧƿdĂ . 2Ƨơljdž!ƒ ΣƱǤʒ!ƒ þƪ!ƒ Ƨƿdž

Coefficient of Discharge For the Normal and Oblique Weirs with Semi-Circular Crest

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ABSTRACT

The coefficient of discharge of normal and oblique weirs with semicircular crest under free over flow conditions was studied experimentally. Forty-five weir models were constructed and tested.These models classified in to five groups based on the variation of oblique angle with the canal wall (θ)[group one (θ=90°), group two (θ=60°), group three (θ=45°), group four (θ=30°), group five (θ=25°)]. Each group included three series of tests depending on the variation of downstream face slope (β)[series A (β=75°), series B (β=60°), series C (β=45°)].The upstream slop was fixed for all models with angle (α =75°) and the crest radius (R=5) cm. Every series included testing of three models based on the variation of weir height [P=30,20&10 cm].

The experimental results of the study showed that the discharge coefficient (Cd) increases with the increase of water depth above the crest to the weir height ratio(H/P), and with the increase of downstream slope(β) the peak values of (Cd)were found when downstream face slope (β=75°) and weir height (P=10 cm). In case of oblique weirs, it was found that (Cd) decreases with increase of (H/P) values. Also it was found that (Cd) increases with the increase of the downstream slope (β) & weirs of small oblique angle (θ) give low values of (Cd).

Keywords: Weirs; Free-fall Structures Experimental Study

أستلم في 2004/10/17 قبل في 2005/7/25

$= C_d$

$= g$

$= h$

$= L$

$= P$

$= Q_{NC}$

$= Q_{NS}$

$= Q_{OB}$

$= R$

$= Re$

$= V$

$= B$

$= \mu$

$= \rho$

$= \theta$

$= \alpha$

$= \beta$

$= f, f_1, f_2$

(R)

(Ramamurthy and Vo 1994)

(β)

(θ)

(H/P)

(Ibraheem et al.,1988)

ѣĂùƺ LJǴōƧɳ!ƒ ƒ ƒĂƤ ŀǃƒƧþ! lþþơďǀ!ƒ ƧƬǴǉƶ!ƒ ƔĂǀǃD ǄƒþƤƙǃǴƕ (Abid AliÜ1989) ŀơǴƕ!ƒ ǄǴp Ǵďǂ
ƻōƧƬƙ!ƒ ýďƓƶďǀ LJD þɳĂĂ LJǴōƧɳ!ƒ ỳƱlďǀ ǏǀƵ ǴōþĂďƵ ŀƵĂưĂď!ƒ lƧōþƙǃďǀ!ƒ ŀďǀ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ þĂþǃ!ƒ
.ǴnjƙďǀþlďǀǑƺ ŀǃǴlďǀ!ƒ ƇǴďǀ!ƒ ŀǉơƬĂ ƩƱƓƺ!ƒ þǃǀ! ŀōǃþǉnj!ƒ þǴƶƕǚ! ŀ!ƒþ ỳλďǀō

ѣĂùƺ LJǴōƧɳ!ƒ ƒ ƒǴƬƤ ǏǀƵ ŀǃƒƧþ ƇƒƧɳďǀƕ (Ramamurthy and VoÜ1994) LJǴλơǴƕ!ƒ ǄǴpĂ
:ǑǀōǴďǀ ǴɳƙǉƙǃƒNƑǴƙǉ!ƒ ỳōǀơƙ þƶƕĂ. ŀōƧƒƒþ!ƒ ŀƺǴơ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ þĂþǃ!ƒ

ƻōƧƬùƙ!ƒ ỳùďǀǴƶďǀ LJǴùƺ (β=45°)ƧƤƋďǀ!ƒ ỳōďǀĂ (α =90°) ƩƱƓƺ!ƒ þǃ!ƒ ǄþlďǀỳōďǀLJĂǂō ǴďǀþǉƵ -1
ŀƕǃǉ lþǴōƨƕ Ⅱ!ŘĂ lþǴơ!ƒ ŀƺǴơ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ þĂþǃǀ! ƻōƧƬƙ!ƒ ýďƓƶďǀ ŀďōp LJďǀ ƔƧƙlō LJD Ǐ!ǫ ýlō(C_d)
.(5.5)LJƵ (H/R)ŀďǀ!ƒ ƧƱp ƻƬǉ Ǐ!ǫ ƩƱƓƺ!ƒ þǃ!ƒ ŀďp ѣĂƺ ƇǴďǀ!ƒ ƳǴƺƙƧƒ

ƧƤƋùďǀ ỳùōďǀ ƘōƕλƙþǉƵ ǴōƬďǀǴNj LJĂǂō (C_d) ƻōƧƬƙ!ƒ ýďƓƶďǀ ǏǀƵ ƩƱƓƺ!ƒ þǃ!ƒ ǄþlďǀỳōďǀƧōλƙ LJǫ -2
lþǴōƨƕ þƒþƨƙ (C_d) ŀďōp LJǴƺ (H/R>3)ŀƕǃǉ!ƒ þǉƵ ƩƱƓƺ!ƒ þǃ!ƒ ǄþlďǀỳōďǀƘōƕλƙþǉƵ ǴďǀǚƩƱƓƺ!ƒ þǃ!ƒ
.ƩƱƓƺ!ƒ þǃ!ƒ ƧƤƋďǀ ỳōďǀ

ŀǃùƱƓƺ!ƒ þĂþǃù!ƒ ѣĂƺ LJǴōƧɳ!ƒ ƒ ƒǴƬƤ ŀǃƒƧþƕ (Chilmerran, T. A. 1996) ŀơǴƕ!ƒ ǄǴpĂ
þĂþǃù!ƒ LJǀƈ Ǐù!ǫ ỳƬĂƙĂ.ǴōƧƕƙƤďǀ Ƨơ!ƒ LJǴōƧɳ!ƒ ƘǙǴơ ƘơƙŀƺǴơ!ƒ ŀōƧƒƒþ ƻƬǉ ǗŀƺƧơǉďǀ!ƒĂ ŀōþĂďǀƶ!ƒ
ŀùƺǴǂ! lþǴùơ!ƒ ŀùƺǴơ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ þĂþǃ!ƒ LJďǀ ỳưƺƒ ƇƒþD ѣlơƙ ŀōƧƒƒþ!ƒ ƻƬǉ ŀƺǴơ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ
.ƻōƧƬƙ!ƒ ýďƓƶďǀ ƔǴǃơ! ŀďǀǴƵ ŀþǚƵ ɯǴƙǉƙǃƒ Ǐ!ǫ ỳƬĂƙ Ǵďǂ ǗƘǴƵǴƺƙƧǙƒ

ĂD ŀōƧƒƒþ!ƒ ŀďǀ!ƒ ƘƒŘ ƠƺǴƱďǀ!ƒ ƒ ƒǴƬƤ ŀǃƒƧþƕ (Chanson and MontesÜ1998) LJǴλơǴƕ!ƒ ǄǴp
ỳùƬĂƙ þùpĂ .ƘǴƵǴƺƙƧƒ lþƶ!Ă ŀōǉƒĂƱǃǙƒ þĂþǃ!ƒ LJďǀ ǄǴɳơD ŀōǉǴďǀλ ǏǀƵ ŀǃƒƧþ! ƘǀďǀƙƬƒ Řǫ.ŀōǉƒĂƱǃǙƒ
Ƨþùơǉďǀ!ƒ ƧōλǀùƙĂ (D/R) ƧùƱl!ƒ ƻƬǉ Ǐ!ǫ Ǒǀǂ!ƒ þǃ!ƒ ƳǴƺƙƧƒ ŀƕǃǉĂ ŀǉƒĂƱǃǙƒ Ǆɳơ LJD Ǐ!ǫ LJǴλơǴƕ!ƒ
.ƻōƧƬƙ!ƒ ýďƓƶďǀ ǏǀƵƧλƋōǙ þǃ!ƒ ǄþlďǀǑƺ þĂɳĂďǀ!ƒ

þĂþǃù!ƒ ѣĂùƺ LJǴùōƧɳ!ƒ ƒ ƒǴƬƤ! NōƧƕƙƤďǀ ŀǃƒƧþ (Ziba VatanniaÜ1999) ŀơǴƕ!ƒ ăƧɳD
Ǘ ǑơƱǃ!ƒ þƬ!ƒ LJǫ Ǐ!ǫ ỳƬĂƙĂ.ƧĂďǀƺďǀ!ƒĂ Ƨơ!ƒ LJǴōƧɳ!ƒ ƘǙǴơ ƘơƙŀƺǴơ!ƒ lþǴơ!ƒĂǗŀƺƧơǉďǀ!ƒ ŀǃƱƓƺ!ƒ
þùďǀƙƶō ƻƧơǉďǀ!ƒ ƩƱƓƺ!ƒ þǃǀ! ƻōƧƬƙ!ƒ ýďƓƶďǀ LJǫ Ǵďǂ.ƩǴǀ!ƒ ƘǴōþǀďǀ ỳǚƤ ƻōƧƬƙ!ƒ ýďƓƶďǀ ǑƺƧλƋō
.(H/P) ƳǴƺƙƧǙƒ Ǐ!ǫ ѣďƶ!ƒ ŀƕǃǉ ǏǀƵĂ ƻƧơǉďǀ!ƒ ƩƱƓƺ!ƒ þǃ!ƒ ýĂƱ ǏǀƵ

ƘƒŘ ŀƺƧơǉďǀ!ƒ NǃƱƓƺ!ƒ þĂþǃ!ƒ ѣĂƺ LJǴōƧɳ!ƒ ƒ ƒĂƤ (AL-HumaidawaÜ2000) ŀơǴƕ!ƒ ƩƧþĂ
Ǐ!ǫ ǐþƋō Ǵďǀďǀ þǃ!ƒ ŀƺǴơ ỳĂƱ ỳp Ǵďǀǂ (θ) ƻƒƧơǉǙƒ ŀōĂƒƨ Ƙþƒƨ Ǵďǀǂ NǉD ƝǉƙǃD þpĂ.ŀưōƧƶ!ƒ ŀƺǴơ!ƒ
.ƻōƧƬƙ!ƒ ýďƓƶďǀ ƔǴǃơ! ŀďǀƵ ƘǴþǚƵ ɯǴƙǉƙǃ Ǐ!ǫ ỳƬĂƙĂ.(C_d)ƻōƧƬƙ!ƒ ýďƓƶďǀ lþǴōƨ

ƩƱƓùƶ!ƒ þǃùǀ! ŀùōǂō!ĂƧþōnj!ƒ ƒ ƒĂƤ!ƒ ŀǃƒƧþƕ (Al-Tikrity, R., 2000) ŀλơǴƕ!ƒ ƘďǀǴp Ǵďǂ
ƘƒŘ þĂþǃù!ƒ LJD ƝƑǴùƙǉ!ƒ Ƙùǉōƕ.Ƨơ!ƒ LJǴōƧɳ!ƒ ƱĂƧƬ ƘơƙǴōƧƕƙƤďǀ ŀōƧƒƒþ!ƒ ƻƬǉ ŀƺǴơ!ƒ ǐŘ ǐþĂďǀƶ!ƒ
ƱĂùƕNj LJǀƕ ƝƑǴƙǉ!ƒ ƘƬǀƤƙǃƒĂǗ lþǴơ!ƒ ŀƺǴơ!ƒ ƘƒŘ ŀǃƱƓƺ!ƒ þĂþǃ!ƒ LJďǀ ƇƒþD ỳưƺ ŀōƧƒƒþ!ƒ ƻƬǉ ŀƺǴơ!ƒ
.lþǴơ!ƒ ŀƺǴơ!ƒ ƘƒŘ ɯŘǴďǀǉ!ƒ Ǒƺ Nǉďǀ ŀōƧƒƒþ!ƒ ƻƬǉ ŀƺǴơ!ƒ ƘƒŘ ɯŘǴďǀǉ!ƒ Ǒƺ Ƨƕǂƒ ŀďǀ!ƒ ƔƧp LJǴōƧɳ!ƒ ƠƱǃ

LJǴōƧɳ!ƒ ƒ ƒǴƬƤ ŀǃƒƧþƕ .LJĂƧƤǴĂ(Abdel-Azim M. Negm et al.Ü2002) ŀơǴƕ!ƒ ǄǴpĂ
ƇǴƬùǉǫ ǄùƙĂ.NǃùƺǉƘpĂ!ƒ Ǒƺ ǴnjƙơƙĂ ŀƺǴơ!ƒ lþǴơ!ƒ ŀƬǀďǀ!ƒ ŀǀōƱƙǃďǀ!ƒ ŀǃƱƓƺ!ƒ þĂþǃ!ƒ ѣĂƺ ƔǂƧďǀ!ƒ
ỳǴǂùƬǙĂ Ɣùǂƶďǀ!ƒ Ǒǂō!ĂƧþùōnj!ƒ ƋƬǉďǀ!ƒ ỳǚƤ LJďǀ ƧĂďǀƺďǀ!ƒĂ Ƨơ!ƒ LJǴōƧɳ!ƒ ŀ!Ǵơ! Ǒǂō!ĂƧþōnj!ƒ ɯŘĂďǀǉ!ƒ
.ƻōƧƬƙ!ƒ ƔǴǃơ! ŀďǀƵ ŀþǚƵ Ǐ!ǫ LJĂλơǴƕ!ƒ ỳƬĂƙĂ .ŀƙλďǀĂ ŀǀōƱƙǃďǀǗŀƺƙƤďǀ

ăþǴŀǌǀǀƈ ǚǅỳǋƐ

ǄĂōǉďǀ!Ǘƒ LJďǀ ƧƶpĂ ŀōɳǴɳƨ LJƒƧþɳ ƘƒŘ ǗỳōƱƙǃďǀ ỳƱlďǀƕ ŀơĂƙƒďǀ lǴǉp Ǒƺ ƔƧǴɳƙ!ƒ ƘōƧɳD
ŀōùưƧD ǏùǀƵ ǐþōþơ ỳǂōNj ѣĂƺ ŀƙλƒďǀ lǴǉl!ƒĂ.ǄǃƓ(45)ƳǴƺƙƧƒĂ Ǆǃ (30) ƲƧƵĂ Ǆ(10) ỳĂƱƕ ƩǀďǀD
ǴùďǀǂѣþƙǃùďǀƘ ƩǴǀďǀ!ƒ ỳďōƙ Ǒƙ! ŀ!ƨǉďǀ!ƒ ŀƕƧǀ! ŀǀnj!ƒ ŀǂƧơ!ƒ ƧƺĂƙ ŀǂǃ lǴǉl!ƒ ѣĂƺ þɳĂƙĂ.ƧƕƙƤďǀ!ƒ
þùpĂ (ǄǴùɳ!ƒĂ Ⅱǉƒƨ!ƒ) ƔƬƤ LJďǀ Ƙƶǉ Ƭ ǗǴɳŘĂďǀǉ (45) ƒ ơƺĂ ƇǴƬǉǫ ǄǀƘ ŀơōǗ (1) ỳǂƬ!ƒ Ǒƺ ƠưĂďǀ
LJǴùōƧɳ ƧōλǀùƙLJďǀ ǴnjƙďǀĂǴǀďǀ lþǴōƨĂ ǴnjƙǉĂƬƤ LJďǀ ỳōǀƙǀ! ǑǉNjþ!ƒ ƸƕƬ!ƒĂ LJƬǀďǀǙǓƒ ƸƕƬƕ ƘƶƕƬĂ ƘǀǀƝƬ
] (θ) lǴùǉ!ƒ ƧƒþùɳỳǚďǀǴùnjƺƒƧơǉ ŀōĂƒƨ ǏǀƵ þǴďǀƙƵǙǴƕ ỳōďǀǴɳďǀ (5)Ǐ!ǫ ɯŘǴďǀǉ!ƒ ƘďǀǃþĂ.ǴnjōǀƵ ƇǴďǀ!ƒ
ŀùƵĂďǀɳďǀ!ƒĂǗ(θ=45°) ŀùλ!ƓλǀƒŀƵĂďǀɳďǀ!ƒĂǗ(θ=60°) ŀōǉǴλ!ƒ ŀƵĂďǀɳďǀ!ƒĂǗ (θ=90°) Ǐ!ĂǙƒ ŀƵĂďǀɳďǀ!ƒ

[illegible] [(θ =25°) [illegible] (θ=30°) [illegible] (β=60°) B [illegible] (β =75°) A [illegible] (β) [illegible] [α=75°] [illegible] [(β =45°) C [illegible] (1) [illegible] (P=30,20,10) [illegible] [R= 5] [illegible] (2) [illegible].

[illegible] (B.S.I 1965) [illegible] (315) [illegible] (2.5) [illegible] (7) [illegible] (White 1977) [illegible] (40) [illegible] (Q_{NC}) [illegible] (H) [illegible] (P) [illegible] (H) [illegible] (Q_{NS}) [illegible] (Rehbock).

$$Q_{NS}=\frac{2}{3}\, C_d \sqrt{2g}\, L\, H_e^{1.5} \qquad \text{...................(1)}$$

$$C_d=(0.602+ 0.083\,\frac{H}{P})$$

$$H_e= (H+0.0012)$$

:[illegible]

Q_{NS}= [illegible]

P= [illegible]

-: [illegible]

$$C_d = \frac{Q_{NC}}{\frac{2}{3}\sqrt{2g}\,LH^{1.5}} \qquad \text{.................(2)}$$

: [illegible]

Q_{NC} = [illegible]

[illegible]

[illegible]

-: [illegible]

$$f(q, H, P, g, \rho, \mu, \beta, \theta)=0 \qquad \text{.................(3)}$$

: [illegible]

(L^3/T.L) [illegible] =q

(L) [illegible] =H

[illegible] =P

(L/T^2) [illegible] =(L) g

(M/T^3) [illegible] = ρ

[illegible] = μ

[illegible] = (M/T.L) β

[illegible] = θ

[illegible] [(pie-Theorem) [illegible]] [illegible]

[illegible] (q[illegible]μ)

$$\frac{Q_{NC}}{\frac{2}{3} * \sqrt{2g} * B * H^{3/2}} = C_d = f_1 \left(\frac{H}{P}, Re, \beta, \theta\right) \qquad \ldots\ldots\ldots\ldots\ldots(4)$$

$$C_d = f_2 \left(\frac{H}{P}\right), \beta, \theta) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

[illegible] (Re) [illegible] (4) [illegible] (5) [illegible]

[illegible]

[illegible] (C_d) [illegible] -1:

[illegible] (C_d) [illegible] (5،4،3،8،9،7،6) [illegible] (C_d) [illegible] .(C_d) [illegible]

[illegible] (H/P) [illegible]:
:(C_d) [illegible]

1- [illegible] (C_d) [illegible] (H/P) [illegible] (H/P) [illegible] (p) [illegible] .(Chilmeran 1996) [illegible]

2- [illegible] (C_d) [illegible] (P=10) [illegible] (2) [illegible] (P=20, 30) [illegible] (Noori &Hayawi 1996 ;AL-Qasser 1983 ; Acker 1978) [illegible]

- f [illegible] (β) [illegible] (C_d):

1- [illegible] (C_d) [illegible] (β) [illegible] (0.785-0.718) [illegible] (4) [illegible] (H/P=0.2 , p=30) [illegible] (0.80-0.711) [illegible] (75°-45°) [illegible] (β) [illegible] (H/P=0.16 θ=60°, p= 30) [illegible]

[illegible] (9) [illegible] (Escande&Sananes , 1959) [illegible] (Ramamurthy &Vo 1994) [illegible]

2- [illegible] (p=10) [illegible] (β=75°) [illegible] (2) [illegible]

1- [illegible] (θ) [illegible] :(C_d)

1- [illegible] (C_d) [illegible] (H/P) [illegible] (H/P) [illegible] (Q_{OB}) [illegible] (Ibraheem 1983) [illegible] (Chilmeran 1996) ; (Noori & Hayawi 1996) ; (Noori & Hayawi 1999).

2- [illegible] (0.852) [illegible] (θ=60°, β=75°, P=30) [illegible] (0.567) [illegible] (θ=25°, β=75°, P=30) [illegible] (H/P=0.14) [illegible] (8) [illegible] (AL-Qasser 1983; AL-Humaidawa 2000;).

2- [illegible] :(C_d)

[illegible] (SPSS Ver.10) [illegible] :-

$$C_d = 0.7883 * \left[\left(\frac{H}{P} \right)^{0.01748} * (\sin\theta)^{0.5131} * (\beta)^{0.3127} \right] \quad \ldots\ldots\ldots\ldots\ldots(6)$$

[illegible]:

θ = [illegible] (Degrees).

β = [illegible] (Radian).

[illegible] (10) [illegible] (C_d) [illegible] (C_d) [illegible]

[illegible] (0.926) [illegible].

3- [illegible]:

[illegible] (Chilmeran 1996) [illegible] (θ=60°) [illegible] (P=30,20) [illegible] (R=5) [illegible] (β=75°) [illegible] (β=90°) [illegible]

[illegible] (3) [illegible] (P) [illegible] (H/P) [illegible] (H/P) [illegible] (θ=60°) [illegible] (P) [illegible]

[illegible] (H/P) [illegible] (Escande & [illegible] (Ramamurthy &Vo, 1994);(Sananes,1959).

[illegible]

1- [illegible] (C_d) [illegible] (C_d) [illegible] (H/P) [illegible] (P).

2- [illegible] (β=75°) [illegible] (P=10) [illegible]

3- [illegible] (β) [illegible] (C_d) [illegible]

4- [illegible] (θ=25°) [illegible] (θ=60°، 45°، 30°).

[illegible]

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ƕƨƐƥơǁƐ Ĭƺ ƕĎǒơǀŀƨĎǁƐ ŀƤĴĎžǁƐ üĭŢĴƺŀ :(1)üǋơǁƐ

Crest Height P(cm)	Crest Length L (cm)	Downstream angle (β)	Upstream angle (α)	Series No.	Crest Radius R (cm)	ObLique angle (θ)	ModeL No.	group No.
30 , 20 , 10	30	75°	75°	A	5	90° (Normal weir)	1 - 3	1
30 , 20 , 10	30	60°		B			4 - 6	
30 , 20 , 10	30	45°		C			7 - 9	
30 , 20 , 10	34.6	75°	75°	A	5	60°	10 - 12	2
30 , 20 , 10	34.6	60°		B			13 - 15	
30 , 20 , 10	34.6	45°		C			16 - 18	
30 , 20 , 10	42.424	75°	75°	A	5	45°	19 - 21	3
30 , 20 , 10	42.424	60°		B			22 - 24	
30 , 20 , 10	42.424	45°		C			23 - 27	
30 , 20 , 10	60	75°	75°	A	5	30°	28 - 30	4
30 , 20 , 10	60	60°		B			31 - 33	
30 , 20 , 10	60	45°		C			34 - 36	
30 , 20 , 10	70.98	75°	75°	A	5	25°	37 - 39	5
30 , 20 , 10	70.98	60°		B			40 – 42	
30 , 20 , 10	70.98	45°		C			43 – 45	

ƕƨƐƥơǁƐ ŀƤĴĎž ƲĭĎžǁ ƹĭƥŢŀǁƐ üĎĴƴĎǁ ǌƥƹŢǁƐǌ ĂĎưƴǁƐ ƕĎĭƨǁƐ:(2)üǋơǁƐ

ƹĭƥŢŀǁƐ üĎĴƴĎ										
β=45°			β=60°			β=75°			(θ°)	P (cm)
Min.	Max.	H/P	Min.	Max.	H/P	Min.	Max.	H/P		
0.750	0.821	0.860	0.777	0.856	0.835	0.838	0.899	0.810	°90	10
0.643	0.743	0.530	0.687	0.818	0.480	0.750	0.931	0.402	60°	
0.586	0.675	0.440	0.635	0.743	0.400	0.692	0.847	0.320	°45	
0.466	0.553	0.405	0.514	0.649	0.300	0.584	0.671	0.340	°30	
0.453	0.567	0.300	0.473	0.586	0.300	0.516	0.632	0.310	°25	
0.711	0.758	0.400	0.747	0.809	0.404	0.790	0.850	0.395	°90	20
0.599	0.711	0.265	0.639	0.782	0.230	0.709	0.871	0.210	60°	
0.554	0.651	0.210	0.602	0.704	0.218	0.649	0.795	0.215	°45	
0.438	0.522	0.205	0.485	0.617	0.155	0.556	0.649	0.150	30°	
0.424	0.530	0.150	0.447	0.558	0.155	0.486	0.584	0.170	25°	
0.664	0.743	0.233	0.709	0.790	0.240	0.73	0.825	0.237	90°	30
0.586	0.693	0.160	0.619	0.759	0.155	0.675	0.852	0.137	60°	
0.531	0.636	0.145	0.588	0.689	0.145	0.637	0.785	0.103	45°	
0.427	0.507	0.143	0.474	0.600	0.123	0.536	0.639	0.103	30°	
0.412	0.498	0.107	0.429	0.548	0.100	0.475	0.567	0.127	25°	

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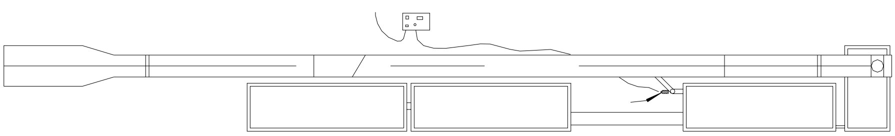
(2 - 1)	(2) (β=90°)	(1) (β=75°)	H/P	ƠƓƺƸ ƴƸ Ƹ ƧƓƸ p(cm)	ƕǏƊƸ ƚƉǆ ƍ ƸƠƸƸ (θ)ƔƸƸƸ ƸƸ
Δ Cd (%)	ǈƉǆƳƉǆ ƉǆƉǆ (Cd) ƍ ǎƸ Ƭ ƵƸ ƉǏ ƸƠƸ ǈƸ	(Cd) ƍ ǎƸ Ƭ ƵƸ ǈƉǆƳƉǆ ƕǏƸƠƸ ƕƸƸƴƸ			
-24.11	0.591	0.7335	0.14	30	90°
-7.63	0.695	0.748	0.16		
-27.71	0.599	0.765	0.18		
-29.00	0.607	0.783	0.2		
-30.47	0.617	0.805	0.22		
-35.04	0.585	0.790	0.28	20	
-36.22	0.588	0.801	0.3		
-37.16	0.592	0.812	0.32		
-38.32	0.595	0.823	0.34		
-39.30	0.598	0.833	0.36		
-19.01	0.710	0.845	0.14	30	60°
-11.42	0.718	0.800	0.16		
-6.59	0.713	0.760	0.18		
-1.41	0.71	0.720	0.2		
0.00	0.706	0.706	0.22		
-24.66	0.734	0.915	0.18	20	
-20.90	0.732	0.885	0.20		
-17.65	0.731	0.860	0.22		
-14.35	0.7311	0.836	0.24		
-10.58	0.7325	0.810	0.26		



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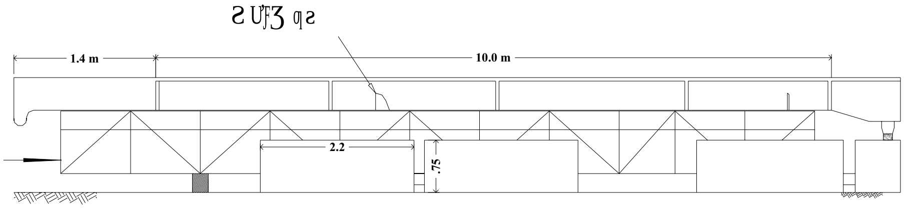

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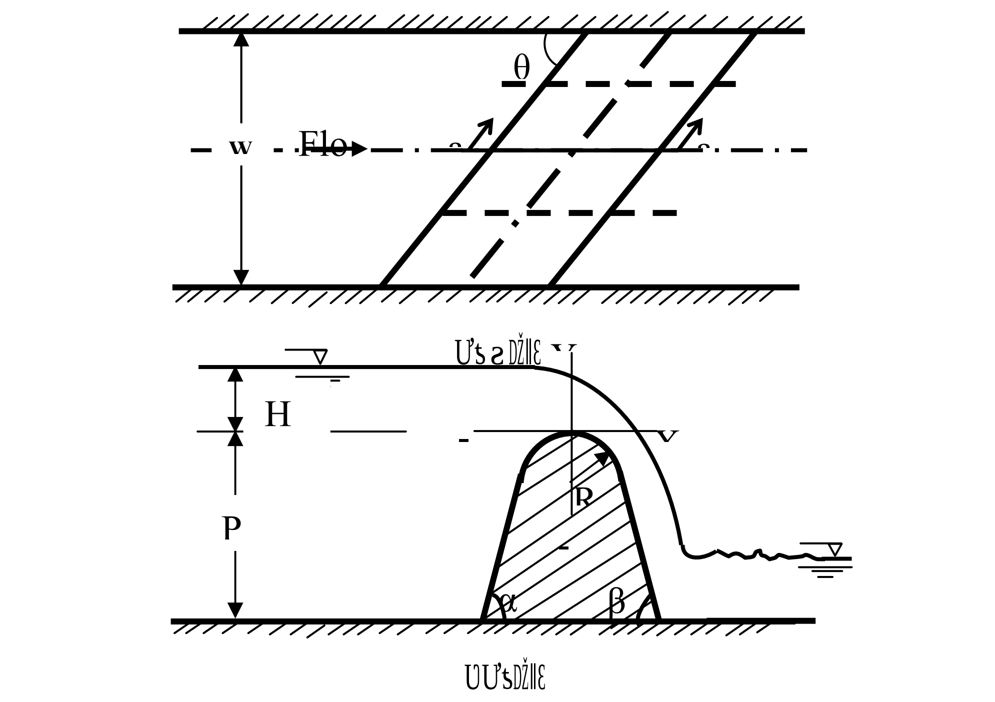

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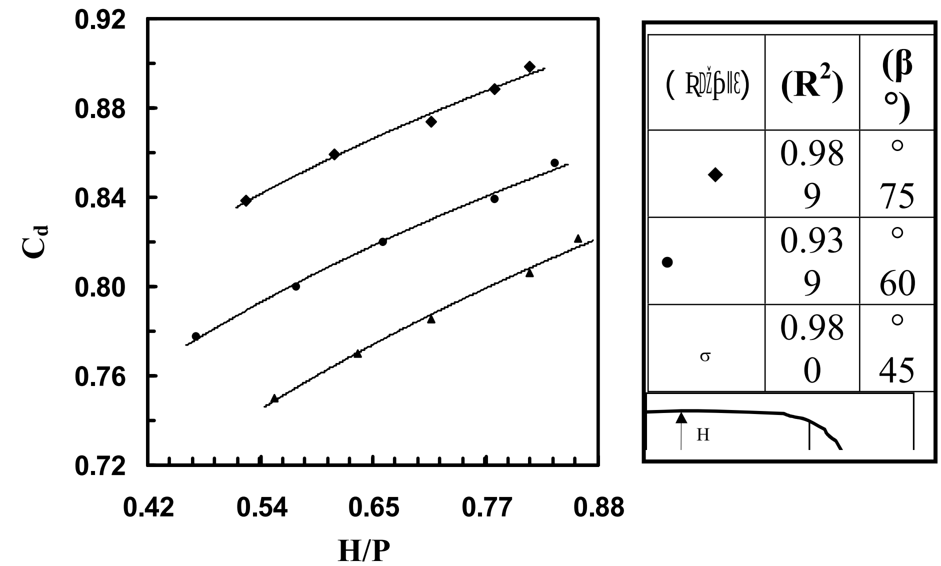

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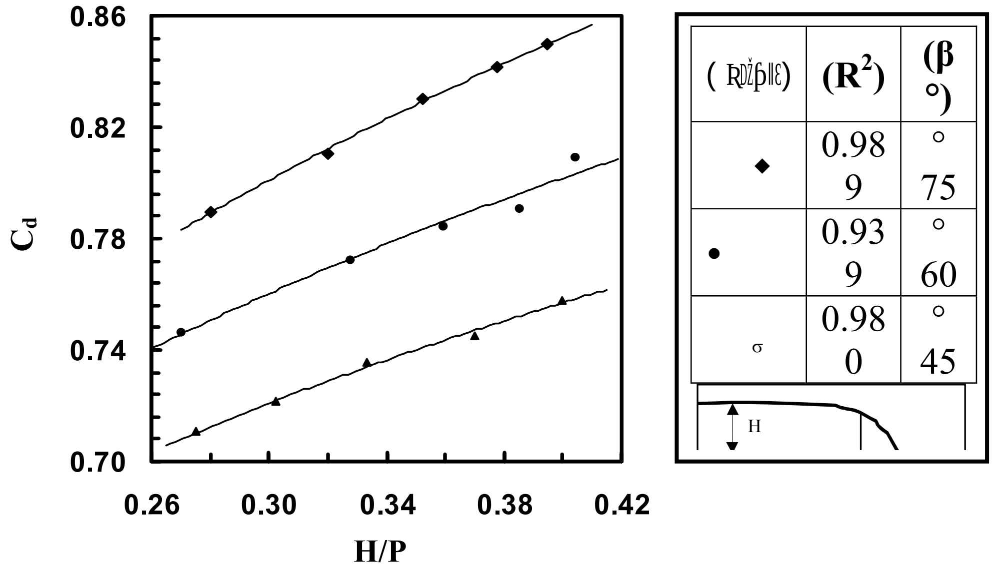

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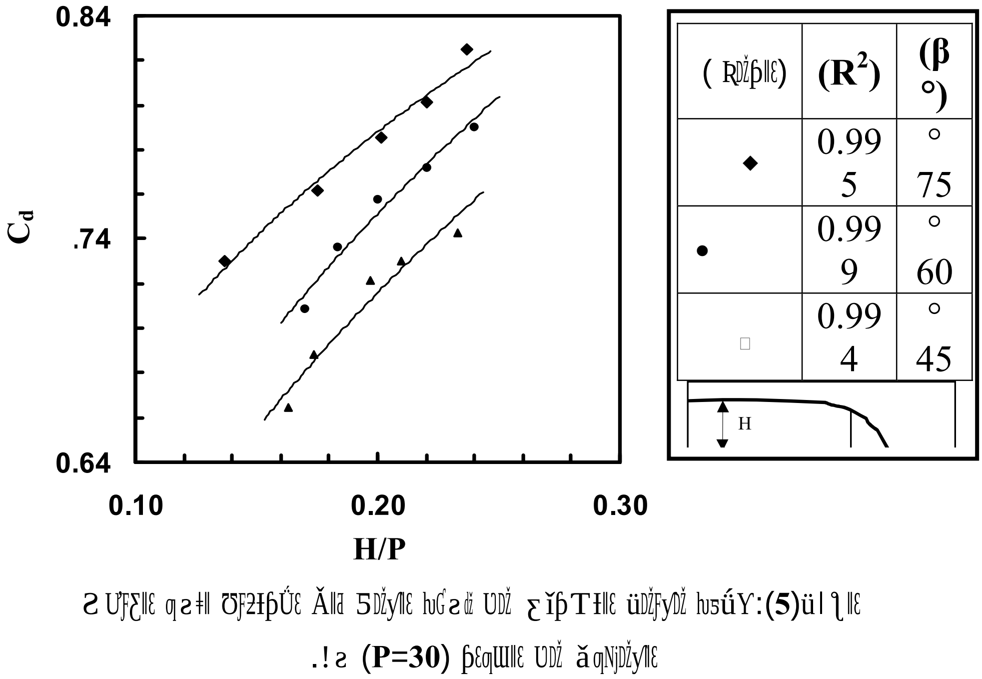

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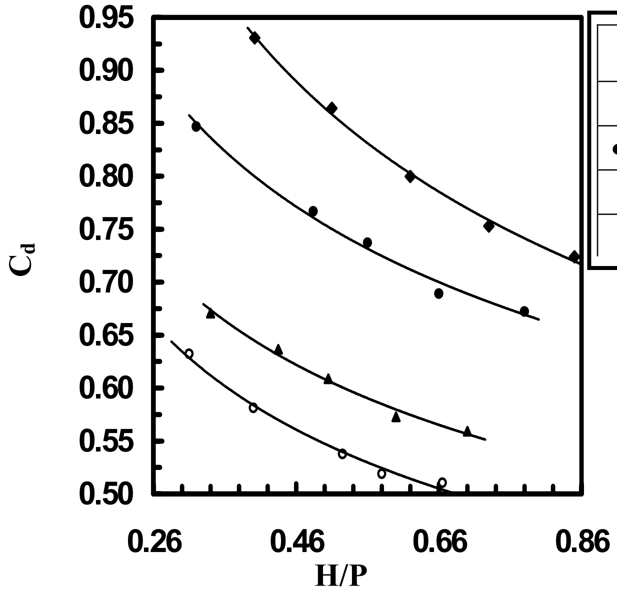

(ǂƊžƥǁƐ)	(R^2)	(θ°)
◆	0.996	60°
●	0.988	45°
σ	0.988	30°
○	0.989	25°

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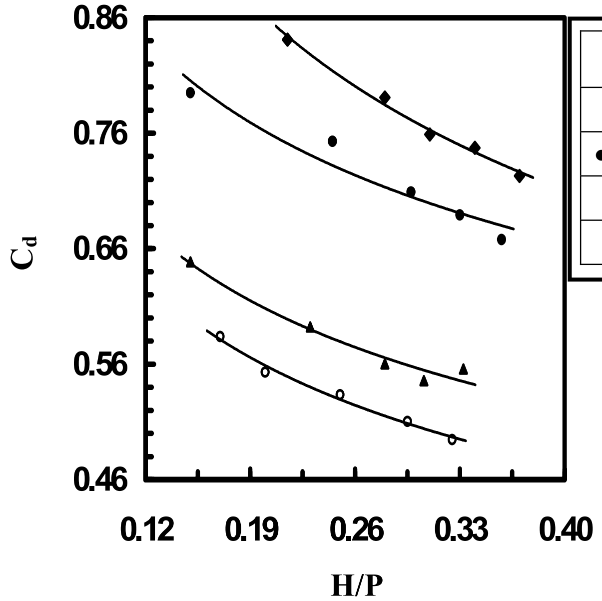
.(**β=75°**Û! ƨ **P=10**) ƥƐǭǀǁǁƐ ƊžY



(ǂƊžƥǁƐ)	(R^2)	(θ°)
◆	0.988	60°
●	0.938	45°
σ	0.960	30°
○	0.987	25°

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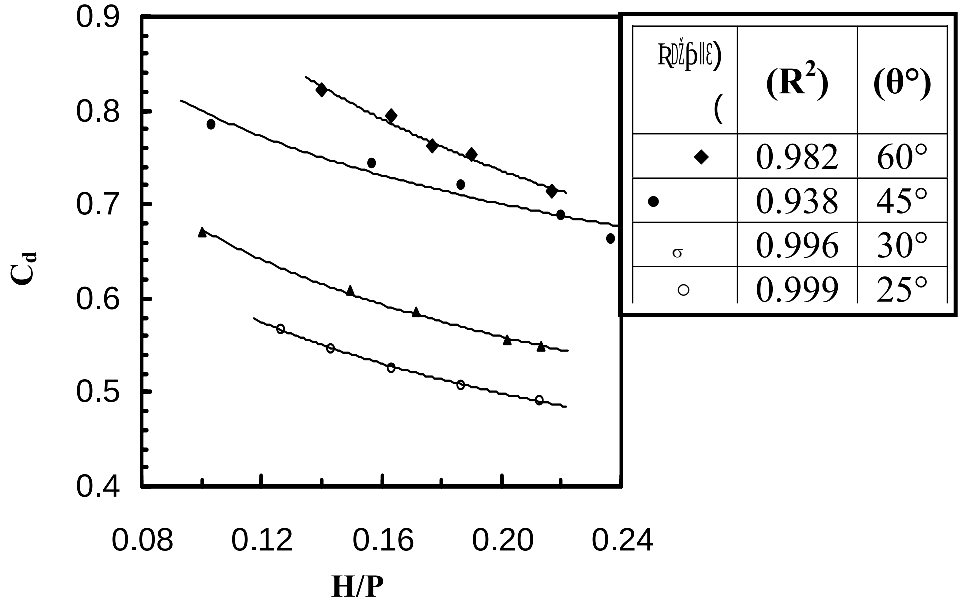

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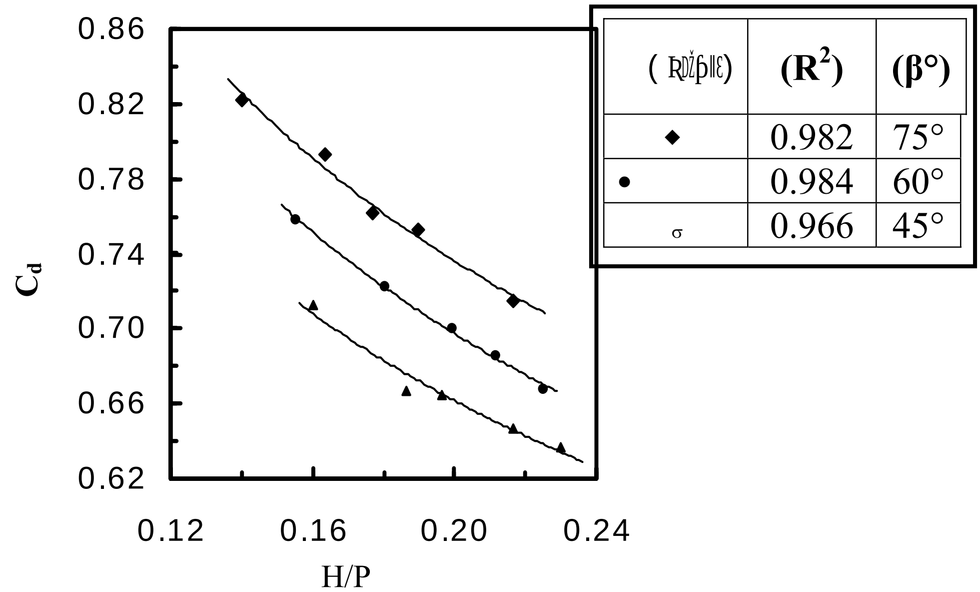

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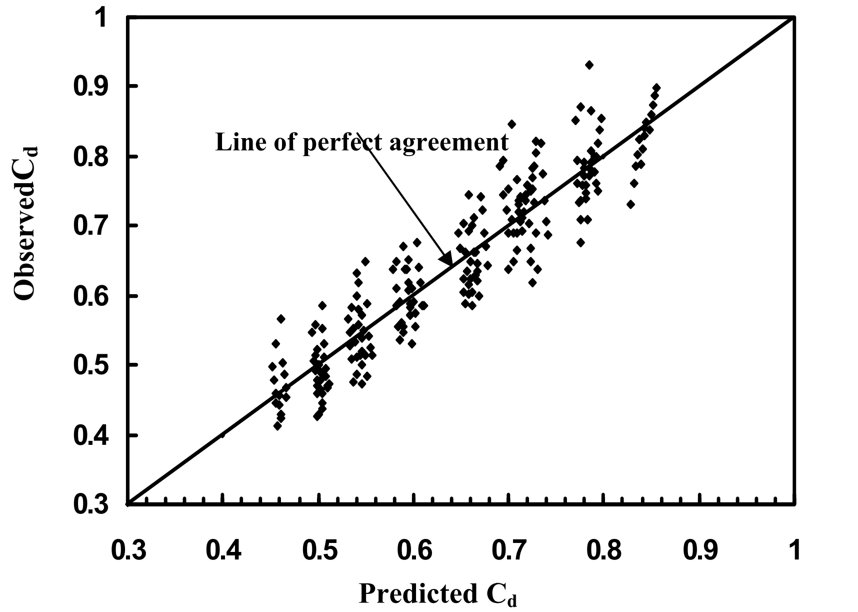
.(θ=60°ǕƊǃ P=30) Ƨƒƥƞ!ƒ ǇƵ



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. **(6)**ƕɑűyǁ ĎžĎ