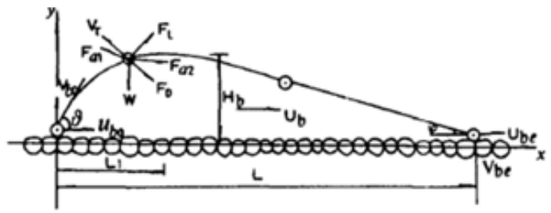

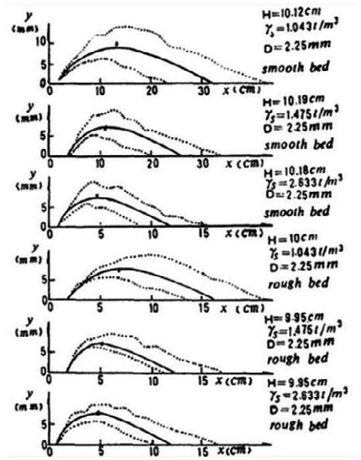

论文类成果

推移质运动 I：力学特性

【创新性】

跃移运动（Saltation）是推移质运动的主要形式。自从 1914 年 Gilbert 开始，许多学者对此开展过研究。但受仪器精度限制，跃移性质并不清楚。为此本文基于大量实验对跃移力学特性开展研究，取得如下创新成果：(1) 界定了推移质滚动、跃移、悬浮的比例：滚动、跃移、悬浮是泥沙颗粒运动三种主要形式，其运动强度与水流运动强度函数 Θ 直接相关，推导了三种运动状态的百分数，结果表明当 0.1<Θ<2.0 跃移占主导，占推移质运动总量的 70%。(2) 给出了推移质跃移的运动学特性：给出了典型跃移的轨迹、径向和垂向的速度、加速度、以及颗粒跃移速度与水流速度差，以及多项跃移特征参数，包括最大跃移高度 (Hb=2D−4D)、最大跃移长度 L =15D−20D 等。(3) 给出了推移质跃移动力学特性：绘制了推移质跃移运动的受力图，分析了拖曳力、上举力、附加质量力、流体加速环绕力、颗粒加速运动的惯性力，推导了拖曳力和上举力系数表达式。(4) 推导了跃移方程及分析解：根据推移质跃移颗粒的受力分析和牛顿定律，推导了跃移方程，并获得了运动轨迹的解析解，与实测资料符合良好。

【影响力】

本文采用高速摄影技术开展了 1000 多组实验，为推移质运动机理研究积累了宝贵资料。从理论上全面研究了推移质跃移运动的运动学和动力学特性，推导了跃移运动方程，其解析解与实验资料符合良好。自 1996 年 在 Journal of Hydraulic Engineering, ASCE 发表以来，累计被引用次数为 61 次，在泥沙运动基本理论研究方面有较大的国际影响力。

主要完成人：胡春宏、惠遇甲
受奖单位：泥沙所

BED-LOAD TRANSPORT. I: MECHANICAL CHARACTERISTICS

【Innovation】

Saltation is a major form of bed load transport. Since 1914, many scholars including Gilbert have conducted researches in this respect. However, saltation property is remained unclear due to the limit of instrument precision. Therefore, this paper presents a study on the mechanical characteristics of saltation based on a great number of experiments, and obtains following innovative results. First, it defines the proportions of rolling, saltation and suspension of bed load: rolling, saltation and suspension are major forms of sediment movement, whose movement intensity function is directly correlated with water flow movement intensity Θ, so this paper deduces the percentages of the three movement status, according to which saltation takes the leading position by taking up 70% of bed load transport when 0.1<Θ<2.0. Second, it presents the kinematical characteristics of bed load saltation: including the track, radial and vertical speeds, acceleration, the difference between particle saltation speed and water flow speed in typical saltations, and many other characteristic parameters of saltation such as the maximum saltation height (Hb=2D−4D), maximum saltation length (L =15D−20D) and etc. Third, it presents the mechanical characteristics of bed load saltation: it draws the force diagram of bed load transport, analyzes drag force, uplift force, added mass force, accelerated circling force of fluid and inertia force of accelerated movement of particles, and deduces the expressions of drag force and uplift force factors. Finally, it deduces saltation equation and its analytical solution: according to the force analysis of particles in bed load transport, it deduces the saltation equation, and obtains the analytical solution to movement track, which agrees well to the measured data.

【Influence】

In this paper, more than 1,000 runs of experiments were conducted using the high-speed photography technology, accumulating precious data for the research of bed load transport mechanism. The kinematic and mechanic characteristics of bed load saltation were studied comprehensively and theoretically, and the saltation equation was deduced, whose analytical solution matches well with experimental data. Since it was published on the Journal of Hydraulic Engineering, ASCE in 1996, the paper has registered more than 60 citations, with a great international influence in the research of the basic theory of sediment movement.

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Award-winning Unit : Department of Sediment Research