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Water wheel design has evolved over time with some water wheels oriented vertically, some horizontally and some with elaborate pulleys and gears attached, but they are all designed to do the same function and that is too, "convert the linear motion of the moving water into a rotary motion which can be used to drive any piece of machinery connected to it via a rotating shaft". Typical Waterwheel Design Early Waterwheel Design were quite primitive and simple machines consisting of a vertical wooden wheel with wooden blades or buckets fixed equally around their circumference all supported on a horizontal shaft with the force of the water flowing underneath it pushing the wheel in a tangential direction against the blades. These vertical waterwheels were vastly superior to the earlier horizontal waterwheel design by the ancient Greeks and Egyptians, because they could operate more efficiently translating the momentum of the moving water into power. Pulleys and gearing was then attached to the waterwheel which allowed a change in direction of a rotating shaft from horizontal to vertical in order to operate millstones, saw wood, crush ore, stamping and cutting etc. Types of Water Wheel Design Most Waterwheels also known as Watermills or simply Water Wheels, are vertically mounted wheels rotating about a horizontal axle, and these types of waterwheels are classified by the way in which the water is applied to the wheel, relative to the wheel's axle. As you may expect, waterwheels are relatively large machines which rotate at low angular speeds, and have a low efficiency, due to losses by friction and the incomplete filling of the buckets, etc. The action of the water pushing against the wheels buckets or paddles develops torque on the axle but by directing the water at these paddles and buckets from different positions on the wheel the speed of rotation and its efficiency can be improved.http://aulac.com.vn/userfiles/canon-powershot-780-is-user-manual.xml

The two most common types of waterwheel design is the "undershot waterwheel" and the "overshot waterwheel". The Undershot Waterwheel Undershot Water Wheel Design The Undershot Water

Wheel Design, also known as a “stream wheel” was the most commonly used type of waterwheel designed by the ancient Greeks and Romans as it is the simplest, cheapest and easiest type of wheel to construct. In this type of waterwheel design, the wheel is simply placed directly into a fast flowing river and supported from above. The motion of the water below creates a pushing action against the submerged paddles on the lower part of the wheel allowing it to rotate in one direction only relative to the direction of the flow of the water. This type of waterwheel design is generally used in flat areas with no natural slope of the land or where the flow of water is sufficiently fast moving. Compared with the other waterwheel designs, this type of design is very inefficient, with as little as 20% of the waters potential energy being used to actually rotate the wheel. Also the waters energy is used only once to rotate the wheel, after which it flows away with the rest of the water. Another disadvantage of the undershot water wheel is that it requires large quantities of water moving at speed. Therefore, undershot waterwheels are usually situated on the banks of rivers as smaller streams or brooks do not have enough potential energy in the moving water. One way of improving the efficiency slightly of an undershot waterwheel is to divert a percentage off the water in the river along a narrow channel or duct so that 100% of the diverted water is used to rotate the wheel. In order to achieve this the undershot wheel has to be narrow and fit very accurately within the channel to prevent the water from escaping around the sides or by increasing either the number or size of the paddles.

The Overshot Waterwheel Overshot Water Wheel Design The Overshot Water Wheel Design is the most common type of waterwheel design. The overshot waterwheel is more complicated in its construction and design than the previous undershot waterwheel as it uses buckets or small compartments to both catch and hold the water. These buckets fill with water flowing in at the top of the wheel. The gravitational weight of the water in the full buckets causes the wheel to rotate around its central axis as the empty buckets on the other side of the wheel become lighter. This type of water wheel uses gravity to improve output as well as the water itself, thus overshot waterwheels are much more efficient than undershot designs as almost all of the water and its weight is being used to produce output power. However as before, the waters energy is used only once to rotate the wheel, after which it flows away with the rest of the water. Overshot waterwheels are suspended above a river or stream and are generally built on the sides of hills providing a water supply from above with a low head the vertical distance between the water at the top and the river or stream below of between 5to20 metres. A small dam or weir can be constructed and used to both channel and increase the speed of the water to the top of the wheel giving it more energy but it is the volume of water rather than its speed which helps rotate the wheel. Generally, overshot waterwheels are built as large as possible to give the greatest possible head distance for the gravitational weight of the water to rotate the wheel. However, large diameter waterwheels are more complicated and expensive to construct due to the weight of the wheel and water. When the individual buckets are filled with water, the gravitational weight of the water causes the wheel to rotate in the direction of the flow of water.

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As the angle of rotation gets nearer to the bottom of the wheel, the water inside the bucket empties out into the river or stream below, but the weight of the buckets rotating behind it causes the wheel to continue with its rotational speed. The empty bucket continues around the rotating wheel until it gets back up to the top again ready to be filled with more water and the cycle repeats. One of the disadvantages of an overshot waterwheel design is that the water is only used once as it flows over the wheel. The Pitchback Waterwheel Pitchback Water Wheel Design The Pitchback Water Wheel Design is a variation on the previous overshot waterwheel as it also uses the gravitational weight of the water to help rotate the wheel, but it also uses the flow of the waste water below it to give an extra push. This type of waterwheel design uses a low head infeed system which provides the water near to the top of the wheel from a pentrough above. Unlike the overshot waterwheel which channelled the water directly over the wheel causing it to rotate in the direction of the flow of the water, the pitchback waterwheel feeds the water vertically downwards through a funnel and into the bucket below causing the wheel to rotate in the opposite direction to the flow of the water above. Just like the previous overshot waterwheel, the gravitational weight of the water in the buckets causes the wheel to rotate but in an anticlockwise direction. As the angle of rotation nears the bottom of the wheel, the water trapped inside the buckets empties out below. As the empty bucket is attached to the wheel, it continues rotating with the wheel as before until it gets back up to the top again ready to be filled with more water and the cycle repeats. The difference this time is that the waste water emptied out of the rotating bucket flows away in the direction of the rotating wheel as it has nowhere else to go, similar to the undershot waterwheel principal.

Thus the main advantage of the pitchback waterwheel is that it uses the energy of the water twice, once from above and once from below to rotate the wheel around its central axis. The result is that the efficiency of the waterwheel design is greatly increased to over 80% of the waters energy as it is driven by both the gravitaional weight of the incoming water and by the force or pressure of water directed into the buckets from above, as well as the flow of the waste water below pushing against the buckets. The disadvantage though of an pitchback waterwheel is that it needs a slightly more complex water supply arrangement directly above the wheel with chutes and pentroughs. The Breastshot Waterwheel Breastshot Water Wheel Design The Breastshot Water Wheel Design is another verticallymounted waterwheel design where the water enters the buckets about half way up at axle height, or just above it, and then flows out at the bottom in the direction of the wheels rotation. Generally, the breastshot waterwheel is used in situations were the head of water is insufficient to power an overshot or pitchback waterwheel design from above. The disadvantage here is that the gravitational weight of the water is only used for about one quarter of the rotation unlike previously which was for half the rotation. To overcome this low head height, the waterwheels buckets are made wider to extract the required amount of potential energy from the water. Breastshot waterwheels use about the same gravitational weight of the water to rotate the wheel but as the head height of the water is around half that of a typical overshot waterwheel, the buckets are a lot wider than previous waterwheel designs to increase the volume of the water caught in the buckets. The disadvantage of this type of design is an increase in the width and weight of the water being carried by each bucket.

As with the pitchback design, the breastshot wheel uses the energy of the water twice as the waterwheel is designed to sit in the water allowing the waste water to help in the rotation of the wheel as it flows away down stream. Generate Electricity using a Waterwheel Historically water wheels have been used for milling flour, cereals and other such mechanical tasks. But water wheels can also be used for the generation of electricity, called a Hydro Power system. By connecting an electrical generator to the waterwheels rotating shaft, either directly or indirectly using drive belts and pulleys, waterwheels can be used to generate power continuously 24 hours a day unlike solar energy. Look for Water wheel Generators designed to produce its optimum output at relatively low speeds. For small projects, a small DC motor can be used as a lowspeed generator or an automotive alternator but these are designed to work at much higher speeds so some form of gearing may be required. A wind turbine generator makes an ideal waterwheel generator as it is designed for low speed, high output operation. If there is a fairly fast flowing river or stream near to your home or garden which you can use, then a small scale hydro power system may be a better alternative to other forms of renewable energy sources such as “Wind Energy” or “Solar Energy” as it has a lot less visual impact. Also just like wind and solar energy, with a gridconnected small scale waterwheel designed generating system connected to the local utility grid, any electricity you generate but don’t use can be sold back to the electricity company. In the next tutorial about Hydro Energy, we will look at the different types of turbines available which we could attach to our waterwheel design for hydro power generation.

For more information about Waterwheel Design and how to generate your own electricity using the power of water, or obtain more hydro energy information about the various waterwheel designs available, or to explore the advantages and disadvantages of hydro energy, then Click Here to order your copy from Amazon today about the principles and construction of waterwheels which can be used for generating electricity. Could you give me a hint where I vcan find it. There are many different types of water pumps which can be used in a microhydro turbine application as manufacturers also test their pumps in turbine mode. The torque produced from the output shaft of a pumpasaturbine is converted into electricity by use of a DC or AC generator, whatever is connected to the shaft. It has been prepared by Alternator A very small script that will calculate the theoretical potential hydropower of Hydropower Plant, pdf Water new homebrew hydro plant, Some General Micro Hydro Power Information The Water Baby micro hydro turbine is part of a hybrid 12Volt power system, Read more about how smallscale hydro power works Hydro Manual The basic principle of hydropower is that if water can be piped The energy produced by them is renewable and the process Turbine Installation Manual Documents Undershot wheel, Overshot wheel, Breast wheel, Tub wheel, Outwardflow reaction wheel, Modern hydroelectric turbine, Mills utilize the mechanical Generation DIY Water Wheel Power Generation. Explore 0 Description Imported from USA. Full description not available Show More Reviews Similar Products Microhydro Clean Power from Water Mother Earth News Wiser Living Series by scott davis 4.

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However, eddies generate in two flow channels and can develop initial vortexes earlier than other cases because of the elevation of the upstream water level at an immersed radius ratio of 82.76%.So, they always need much time and huge investments. The stream wheel mainly uses kinetic energy, and the others mainly make use of potential energy. The overshot water wheel, which is recognized as the most effective traditional water wheel, is suitable for high heads. The water flows into cells at the top of the water wheel. The breastshot water wheel, regarded as less effective than the overshot water wheel, is mainly applied in smaller heads than the overshot waterwheel. The water passes the water wheel approximately at the level of the axle. The undershot water wheel is suitable for very low heads. The water passes wheels under the axle of the waterwheel. The stream water wheel can be referred to as a substitutable waterwheel with only employing kinetic energy. Both the undershot and stream water wheel have been much less researched because of their worse performance. However, with development of CFD Computational Fluid Dynamics and urgent demands for exploitation of ultralow water resources, many researchers began to focus on those water wheels that are suitable for open channels, tidal current and rivers. Several experiments and numerical simulations were carried out to characterize the performance of water wheels. Furthermore, 48blade wheels could also produce low turbulence intensity to make less of an effect on flow field. Moreover, the equations about the optimal number of blades were generalized based on the hydraulic and geometric conditions. The results showed that runners with no bottom plate had a better performance at high speeds because of receiving twice the amount of flow; meanwhile, no air bubbles were carried into the gap between the runners.

However, those researches cannot have a generalized conclusion; water wheels still need to be developed for improving their performances. There were also some special turbines that were put forward for exploiting low and ultralow resources. The savonius vertical turbine was brought up to extract energy from low current speeds in rivers and tidal currents. The savonius turbine mainly was applied in wind energy primitively; it is considered to be an effective hydro turbine for low heads because of the low cost and maintenance. It was found that the numbers of blades and the twist angle had a significant effect on the turbine’s performance; however, it still need to further its design to make it commercially work. In numerical simulations, the different turbulence models are adapted to different kinds of flow for improving accuracy.Above all, those researches played an important role in exploiting low head resources and improving water wheel performance. Nowadays most of the water wheels that are designed and constructed still rely on experiences; furthermore, performance and flow characteristics are still unclear and have not been brought into consideration at different immersed depths; therefore, clearing the flow characteristics and improving knowledge of the performance of water wheels at different immersed depths have remarkable significance for further commercial work. So, this paper is concentrated on studying the different immersed depth effects on performance and flow characteristics through numerical simulations. This research conducted the experiments at an immersed depth of 0.8 m based on a realsize model. The optimal immersed depth is identified. The results are expected to enhance the design and knowledge for stream water wheels. 2. Numerical Simulation Method 2.1.

Simulation Model The realsize stream water wheel is an 8blade wheel of a straighttype considered a simple manufacture; diagonal blades will be designed for a better performance in the next researches. The flow depth is 2.2 m, the distance is 13 m from gate to the center of water wheels and the distance To ensure a fully developed water flow, the rotation domain is at the center of the flow domain with a length The hybrid grid is applied in this research with an unstructured tetrahedral mesh in the flow domain and hexahedral mesh in the rotational domain, generated by ICEM CFD. Figure 1 shows the geometric model and grids in the wheel domain. The is defined asIn this research, different working conditions were simulated through changing different immersed depths and rotational speeds. It could be concluded that the nearly 4 million elements are reliable as the torques keep stable. So, this number of the elements is chosen for different cases. In addition, for giving a better evaluation for the ability to extract energy in the stream, the power coefficient The power coefficient The efficiency The velocities were calculated from the center of the water wheel to a distance of 2 D. In order to specify the transition from stream wheel to RHPM, a nondimensional parameter X is defined. Capturing the free surface between water and air is the main problem in the numerical simulation. In addition, the problem of capturing the free surface coupled with rotation is more complex. For solving those problems, the sliding mesh is used to simulate rotational motion and the interface is applied to transform the momentum and energy between the rotation domain wheel domain and stationary domain flow domain. The VOF method in the multiphase model is used to capture the free surface between water and air. CFD simulations are conducted using the commercial software FLUENT. This research includes two phases water and air with a free surface.

The RANS equations are widely used to solve the flow characteristic, considering both efficiency and accuracy in simulation, and volume of the fluid VOF is applied widely in solving the multiphase problems with immiscible fluid. It is necessary to add an additional continuity equation based on RANS in the VOF methods. The main purpose of an additional equation is to ensure the volume fraction of air and water in each cell.In most cases, Then the continuity equation and momentum equations of the mixture could be solved.The qualities So, the turbulence model of The time step is set to 360 steps in a revolution for transient simulations at different TSR. The free surface level is also set at the inlet in multiphase module. The free surface level and bottom level needed to be set for the pressureoutlet in the multiphase module. The symmetry without a physical boundary was chosen for the top of the domain, considering the stability of the calculation. The immersed radius ratio is defined as It is mainly used to measure flow velocity in open channels. The average velocity of 13 points is regarded as the inletvelocity in simulation. The GBM Power Station Control Center manufactured by GBM Co. Ltd. Nanchang, China is applied to measure the output and rotational speeds and it is manufactured by GBM Co. Ltd. The water wheel is connected with an axis of a permanent magnet generator through a gearbox with a transmission ratio of 125. The water wheel's rational speeds can be converted from the rational speeds of the permanent magnet generator. The permanent magnet generator has a very high efficiency and the high torque was generated; the maximum error on the power measurement was estimated as no more than 2%. The GBM Power Station Control Center has two control models when making an automatic adaptation to the optimal speed and manual speed adjustment.

In this experiment, the cases with optimum working condition and other different TSR were experimented at an immersed depth of 0.8 m. The test devices are shown in Figure 4. The field experiments are shown in Figure 5. The comparison of output between the experiments and numerical simulations is shown in Table 1. The results of the simulation are consistent with the output of the experiments as a whole. The maximum error is relatively smaller, no more than 5%. The main reasons for the error are known as follow Mechanical friction is seemed as the main source of the errors. There are also some differences with being a little wider downstream in the physical model than the actual channel; so, the diffusion may cause some hydraulic loss. In addition, the boundary conditions in the numerical simulation may cause some errors compared with actual flow. 4. Results and Discussion 4.1. Evaluation of Water Wheel Performance The different cases are researched at different immersed radius ratios. Table 2 indicates that the power coefficient The performance and optimal Figure 6 indicates that the different immersed ratios have a similar tendency to increase followed by decreasing at different cases. At different immersed depths, the range of increasing and decreasing is slightly different. At an immersed radius ratio 82.76% 1.2 m, the efficiency is increasing until TSR 0.1984, followed by decreasing until TSR 0.4049. At the other three cases, the efficiency performs the same tendency to increases followed by decreasing until TSR 0.3037. In summary, it can be said the operating range performs much wider at the immersed radius ratio of 82.76%; also, it has the same optimal rotational speeds at different cases. In addition, it can be found that the optimal The performance is much better as the immersed radius ratio increases for the stream wheel before an immersed radius ratio of 68.96% 1.0 m; after that, the water wheel at the immersed radius ratio of 82.76% 1.

2 m has the best performance in RHPM in all cases. Above all, it can be said that it shows much better performance at the immersed radius ratio of 82.76% 1.2 m in all cases. In order to describe

the torque fluctuation, a nondimensional parameter The computed torque is shown in Figure 7 a in a revolution at a TSR of 0.1984 at different immersed depths; the The available torque also dramatically increases at the beginning of a period, but the decrease in torque is much slower; the different cases present the same tendency in torque fluctuation. As discussed above, it generates much greater torques at the immersed depth of 1.2 m immersed radius ratio of 82.76%. Moreover, the torque fluctuation is more stable at the immersed depth of 1.2 m than in other cases. Therefore, it can be said it can improve the performance and reduce the torque fluctuation by adding immersed depth until 1.2 m immersed radius ratio of 82.76%. The computed difference in water level is presented in Figure 8 in a revolution at different immersed depths. The free surface is monitored at a TSR of 0.1984 from the center of the water wheel to a distance of 2 D. It is clear that the average difference in water level increases as the immersed depth increases, also it drastically increases, and the maximum is nearly 3 m at the immersed depth of 1.2 m. The fluctuation of.So, it may cause the dramatic vibration and fatigue of the blades, which could pose a considerate threat to the security of the entire system. The high difference in water level may also cause serious erosion.It is investigated at a TSR of 0.1984. The circumferential angle.The comparison of water volume at different immersed depths is presented in Figure 9. The It is clearly seen that the water volume fraction at the inlet phase varies more strongly than the outlet phase as immersed depth increases, especially at an immersed depth of 1.0 m and 1.