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Study on Characteristic Analysis of Closed-Type Sabo Dam with a Flap due to Dynamic force of Debris Flow

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The phenomenon of debris flow as the agent forming alluvial cones in the mouths of mountain canyons has attracted the attention of physiography for more than a century. Debris flows are also of concern to engineers who are responsible for human life and property. Although various kinds of countermeasures have been invented debris flow is still one of the most threatening natural phenomena in some regions in the world (Takahashi. 1981). A sediment disaster is not so large as earthquake, flood, storm surge or tsunami in terms of the size of occurrence, but its threat to human lives is very high because it occurs at multiple locations simultaneously. Therefore, it is important to mitigate damage by establishing effective structural and non-structural measures.

Nature of the debris flow characteristics are the front part of the flow where big boulders accumulate lasts only a few seconds and the following part that lasts long looks like a mud flow with gradually decreasing discharge. Besides, impact force by boulders in a debris flow is much greater than fluid dynamic pressure. Field measurements performed at Mt. Yakedake (Suwa and Okuda, 1983) show that impact forces consist of two distinct parts: fluid dynamic pressures up to 10 kN/m^2 and collisional forces of single boulders up to 10^2~10^4 kN/m^2. The destructive power of debris flow consists of surface pressure due to fluid-phase slurry thrusting and point-wise loading due to coarse solid particle collision. The fluid pressure including hydrostatic and hydrodynamic components strongly depends on fluid density, flow depth, velocity and impact angle, while the solid loading depends on the velocity and size of the largest boulder as well as the geometry and properties of the structures subject to collision. So, we should take impact force of debris flow into consideration when a check dam will be designed.

The objective of this study is to propose new type closed dam and to analyze the improvement in the capturing function of such dams as well as the impact dynamic force of debris flow with bed sediments. The dynamic force of debris flow due to the collision may be determined by filed measurements, laboratory experiments and numerical simulations. But it is very difficult to measure impact force. Because, debris flow are composed of many kinds of sediments size and fraction. The reason behind this is due to the contact area of the sediment particles with the sensor. So, the average value of the impact pressure is determined experimentally by carrying out several experiments under the same conditions.

From this result, the proposed dam type has the ability to capture more sediment sustaining less pressure than the traditional dams under the same debris flow. This comparison demonstrates the future importance of the proposed sabo dam. Flap-T type (triangle type) can be more effective control the uplift pressure more than flap-R type (rectangular type) due to generated the reflected wave and it has more efficiency to capture large debris mass than the vertical one. Furthermore, contact area of the different particles should be one of the important parameters while deciding impact pressure to the dam.