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Study on the Hydrologic Safety of Small Old Reservoirs

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Abstract. There is a great danger in the safety of reservoirs as it has been more than 50 years since small domestic reservoirs were built. This research compared and analyzed flood discharges according to analytic periods of probability precipitation of the 200-year return period by calculating them to review the hydrologic safety of degraded reservoirs. From the analytical result of the precipitation data that have recently been analyzed, it is found that probability precipitation tends to increase. From the analytical result that calculated food discharges of the 200-year return period, it is found that the food discharge of Period 3 is high. This research result is judged to need to increase the measurement ability by recalculating probability precipitation and design flood discharges to secure the hydrologic safety of degraded reservoirs.

Keywords: old reservoirs, Agricultural reservoirs, Analyses on probability precipitation, Design flood discharges

1 Introduction

More than 17,000 middle and small-sized reservoirs that were built in the domestic areas are utilized to supply agricultural water. These middle and small-sized reservoirs were mostly built from 1960s to 1970s. Risks of the structural and dimensional safety always exist as the old reservoirs as it has been more than 50 years since they were built. Actually, the risk of residents who live in downstream areas of reservoirs has increased as old reservoirs including Sandae Reservoir of Gyeongju and Goiyeong Reservoir of Yeongcheon frequently collapsed in 2014. Therefore, this research tries to compare and review 4 reservoirs located in Gyeongsangbuk-do, Korea by comparing them with each other through the analysis on their precipitation data and the calculation of probability precipitation and then by analyzing them through the calculation of the food discharges of the 200-year return period. As and the opening year of rainfall measuring in rainfall observatories of the research subjects is 1960s, the rainfall data are observed then. So it analyzed and compared probability precipitation by classifying the analytical periods of rainfall into 30 years,

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40 years, and more than 40 years and compared and reviewed the reservoirs by calculating the flood discharges of the 200-year return period and then analyzing them.

2 Paper Preparation

This research first analyzed probability precipitation of 4 reservoirs located in Gyeongsan, Pohang, Yeongcheon, and Sangju, Gyeongsangbuk-do, Korea by classifying the rainfall data periods and analyzed them by calculating the flood discharges of the 200-year return period. The classification of the analytical periods of the completion years of each reservoir and the dominant rainfall observatories is shown in Table 1.

Table 1. Summary of the subject reservoirs

Reservoirs	*Completion year*	*Rainfall observatory*	*Year to begin observation*	*Classification of the analytical periods*
Chimbup	1947	Daegu	1961	1961~1990(Period 1)
Naechung	1977	Pohang	1961	1961~2000(Period 2)
Seoungjang	1934	Chupungryeong	1961	1961~2015(Period 3)
Buman	1945	Yeongcheon	1973	1973~1993(Period 1)
				1973~2003(Period 2)
				1973~2015(Period 3)

From the analytical result of probability precipitation according to the analytical periods, it is found that Daegu Observatory's Period 1 (1961 to 1990) is highest and its Period 2 (1961 to 2000) is lowest when the duration time is 60 minutes. It is found that Period 3 is highest when the duration time is 1,440 minutes and it was analyzed to increase by 10.3mm. It is found that Pohang Observatory's Period 2 (1961 to 2000) is highest in the whole periods and it was analyzed to increase by 111.6mm when the duration time is 1,440 minutes. It is found that Chupungryeong Observatory's Period 3 is highest and it was analyzed to increase by 2.6mm when the duration time is 1,440 minutes. It is found that Yeongcheon Observatory's Period 3 is highest and it was analyzed to increase by 3.6mm when the duration time is 1,440 minutes.

Form the analytical result of the 200-year return period, it is found that Chimbip reservoir's flood discharge in Period 1 is highest when the critical duration period is 200 minutes and Naechung reservoir's flood discharge in Period 3 is highest as 66.8 m^3/s when it is 200 minutes, Seoungjang's flood discharge in Period 3 is highest as 6.3 m^3/s when it is 220 minutes, and Buman's flood discharge in Period 2 is highest as 5.9 m^3/s when it is 70 minutes

Table 2. Comparison of the flood discharges of the 200-year return period by analytical period

Reservoirs	Return period(200Yr)					
	critical duration (min)	Period 1 (m^3/s)	critical duration (min)	Period 2 (m^3/s)	critical duration (min)	Period 3 (m^3/s)
Chimbup	70	49.6	90	46.7	70	49.1
Naechung	200	48.3	220	65.5	200	66.8
Seoungjang	220	5.7	190	5.8	190	6.3
Buman	50	5.8	70	5.9	70	5.7

3 Conclusion

This research compared and reviewed Gyeongsan's Chimbup reservoir, Pohang's Naechung reservoir, Sangju's Seoungjang reservoir, Yeongcheon's Bumna reservoir located in Gyeongsangbuk-do by classifying their analytical periods of rainfall and calculating their probability precipitation and flood discharges about the degraded reservoirs in the domestic areas.

From the result, it is found that the duration time of Period 3 is highest as 1,440 minutes and 301.4mm in case of the 200-year return period of Daegu Observatory and the duration time of Period 2 is highest as 1,440 minutes and 392.6mm in case of the 200-year return period of Pohang Observatory. It is found that the duration time of Period 3 is 1,440 minutes and 296.7mm in case of the 200-year return period of Chupungryeong Observatory and the duration time of Period 3 is 1,440 minutes and 250.6mm in case of the 200-year return period of Yeongcheon Observatory. From the result that analyzed the flood discharges of the 200-year return period, it was analyzed that Gyeongsan Chimbup reservoir's flood discharge in Period 1 is $49.6m^3/s$ when the critical time is 70 minutes, Pohang Naechung's flood discharge in Period 3 is $66.8m^3/s$ when the critical time is 200 minutes. It was analyzed that Sangju Seoungjang's flood discharge in Period 3 is $6.3m^3/s$ when the critical time is 190 minutes, Yeongcheon Buman reservoir's flood discharge in Period 2 is $5.9m^3/s$ when the critical time is 70 minutes. As the actual reservoirs of Chimbup, Seoungjang, Buman except Naechung were completed before 1950, they were designed by using the previous rainfall data when compared to the present analytical periods and the lower flood discharges than the reservoirs that were analyzed this time. As the result that analyzed the flood discharges by analytical period has found that the flood discharges are highest in Period 3, it is found that increase in the safety of the degraded reservoirs is needed by increasing the measurement ability through the recalculation of their flood discharges. It is judged that measures for increasing the safety for flood should be prepared by recalculating the design hydrologic quantity of the degraded reservoirs based on this research in the future.

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