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EVALUASI POTENSI OVERTOPPING BENDUNGAN BENER AKIBAT PROBABLE MAXIMUM FLOOD DENGAN HEC-HMS
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INTISARI

Bendungan Bener merupakan bendungan tipe *Concrete Face Rockfill Dam* (CFRD) yang berlokasi di Kabupaten Purworejo, Jawa Tengah, dengan kapasitas tampungan 90,39 juta m³ dan direncanakan sebagai penyedia air baku, irigasi, pembangkit listrik, serta pengendali banjir. Salah satu ancaman terhadap keamanan bendungan adalah *overtopping*, yaitu kondisi ketika muka air waduk melimpas melewati puncak bendungan dan berpotensi memicu keruntuhan. Oleh karena itu, evaluasi kapasitas pelimpah melalui penelusuran banjir waduk perlu dilakukan untuk mengetahui elevasi muka air maksimum pada kondisi banjir ekstrem. Penelitian ini bertujuan menghitung hidrograf *Probable Maximum Flood* (PMF), membandingkan hasil perhitungan manual dengan pemodelan HEC-HMS, melakukan *reservoir routing*, serta mengevaluasi potensi *overtopping* berdasarkan elevasi muka air maksimum terhadap elevasi puncak bendungan.

Data hujan yang digunakan berasal dari satelit *Global Precipitation Measurement* (GPM) IMERG periode 1998–2025. Nilai *Probable Maximum Precipitation* (PMP) dihitung dengan metode *Hershfield* dan diperoleh sebesar 392,56 mm. Distribusi hujan dianalisis menggunakan metode Huff-1, PSA 007 dan *Observed Pattern*, sedangkan hujan efektif dihitung menggunakan metode SCS-CN pada kondisi AMC III. Transformasi hujan-aliran dilakukan menggunakan HSS Gama-I dan HSS Nakayasu, kemudian hidrograf yang dihasilkan ditelusuri melalui waduk menggunakan HEC-HMS.

Debit puncak *inflow* terbesar terjadi pada skenario Nakayasu-Huff-1 sebesar 1400,70 m³/s. Perbandingan antara perhitungan manual dan HEC-HMS menunjukkan deviasi debit puncak kurang dari 1%. Hasil *reservoir routing* menunjukkan elevasi muka air maksimum tertinggi sebesar +353,39 m pada skenario Gama-I Huff-1, sehingga masih terdapat tinggi jagaan 2,61 m terhadap puncak bendungan. Seluruh skenario memenuhi kriteria kapasitas pelimpah berdasarkan SNI 3432:2020. Dengan demikian, berdasarkan analisis hidrologis dan *reservoir routing*, Bendungan Bener tidak berpotensi mengalami *overtopping* pada skenario PMF yang dianalisis.

Kata kunci: Bendungan Bener, *overtopping*, PMF, *reservoir routing*, HEC-HMS.

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ABSTRACT

Bener Dam is a Concrete Face Rockfill Dam (CFRD) located in Purworejo Regency, Central Java, with a storage capacity of 90,39 million m³. The dam is designed to support raw water supply, irrigation, hydropower generation, and flood control. One of the potential threats to dam safety is overtopping, a condition in which the reservoir water level exceeds the dam crest and may lead to dam failure. Therefore, spillway capacity evaluation through reservoir flood routing is required to determine the maximum reservoir water level under extreme flood conditions. This study aims to calculate the Probable Maximum Flood (PMF) hydrograph, compare manual calculation results with HEC-HMS modeling, perform reservoir routing, and evaluate the potential for overtopping based on the maximum water level relative to the dam crest elevation.

The rainfall data used in this study were obtained from the Global Precipitation Measurement (GPM) IMERG satellite product for the period 1998–2025. The Probable Maximum Precipitation (PMP) was calculated using the Hershfield method, resulting in a value of 392,56 mm. Rainfall distribution was analyzed using the Huff-1, PSA 007 and Observed Pattern methods, while effective rainfall was calculated using the SCS-CN method under AMC III conditions. Rainfall-runoff transformation was carried out using the Gama-I and Nakayasu Synthetic Unit Hydrographs, and the resulting hydrographs were then routed through the reservoir using HEC-HMS.

The highest peak inflow occurred in the Nakayasu-Huff-1 scenario, with a discharge of 1400,70 m³/s. The comparison between manual calculations and HEC-HMS modeling showed peak discharge deviations of less than 1%. The reservoir routing results indicated that the highest maximum reservoir water level occurred in the Gama-I-Huff-1 scenario, reaching +353,39 m, leaving a remaining freeboard of 2,61 m below the dam crest. All analyzed scenarios satisfied the spillway capacity criteria based on SNI 3432:2020. Therefore, based on the hydrological analysis and reservoir routing results, Bener Dam does not indicate overtopping potential under the analyzed PMF scenario.

Keywords: Bener Dam, overtopping, PMF, reservoir routing, HEC-HMS