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REVIEWER'S REPORT

Manuscript No.: IJAR- 55542

Title: Optimal design of hydropower tunnels for cost efficiency in Albania

Recommendation:
Accept

Rating	Excel.	Good	Fair	Poor
Originality	Yes			
Techn. Quality	Yes			
Clarity		Yes		
Significance		Yes		

Reviewer Name: Dr. Ashish Yadav

Detailed Reviewer's Report

Reviewer's Comment for Publication.

Acceptance Comment are mentioned below suitable for the paper titled "Optimal design of hydropower tunnels for cost efficiency in Albania"

Reviewer Comments: Accept

Reviewer Comments –

1. Introduction
The paper addresses an important and timely topic in hydropower engineering the optimal sizing of hydropower tunnels to minimize lifecycle economic cost by jointly considering hydraulic friction losses and construction expenses. Given Albania's significant yet underutilized hydropower potential and the planned expansion of hydropower projects, the study is highly relevant for policymakers, project developers, and infrastructure planners. The motivation is clearly articulated, and the paper successfully integrates engineering design, hydraulic analysis, and economic evaluation in a coherent framework. The introduction effectively frames the problem and demonstrates its practical significance.

2. Literature Review
The paper provides a concise yet adequate review of prior research on hydropower tunnel design, hydraulic optimization, life-cycle costing, and economic analysis of water conveyance systems. The contribution of the present work is well-positioned within the existing body of knowledge. Importantly, the study bridges the gap between purely hydraulic optimization and broader financial considerations an area often underrepresented in conventional hydropower design literature. Future extensions could benefit from referencing risk-adjusted investment assessments and probabilistic uncertainty analysis; however, the current review is sufficient for the scope of the study.

3. Solution Approach / Methodology

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The methodology is rigorous, transparent, and replicable. The authors define total system cost as the sum of energy losses due to hydraulic friction, and tunnel construction and reinforcement costs.
The optimal tunnel cross-section is obtained at the economic equilibrium where the marginal cost of frictional losses equals the marginal cost of incremental tunnel enlargement. The model incorporates key physical parameters (flow rate, tunnel length, roughness, pressure) as well as economic variables (energy price, interest rate, inflation). Sensitivity analysis is applied to evaluate uncertainty in rock conditions, internal pressure, and financial assumptions. The mathematical logic is internally consistent, and assumptions are clearly justified.

4. Results and Discussion

The findings are presented clearly and supported by quantitative assessment. The estimated optimal diameters range between 1.6 and 12.0 m, corresponding to velocities of 1.0–1.8 m/s, which fall within accepted international hydropower design practice. The discussion successfully interprets how tunnel geometry interacts with economic drivers, demonstrating that:

- mutual dependence exists between capital cost and operational loss cost
- internal pressure and rock quality strongly influence lining requirements
- energy price fluctuations impact the feasibility window
- macroeconomic variables significantly affect optimal design thresholds

The authors convincingly show that the proposed methodology enables rational decision-making rather than reliance on rule-of-thumb sizing. The generalizability of the framework to other hydropower settings and water conveyance systems is well-argued. A visual summary chart or case-comparison table could further strengthen interpretation but is not essential.

5. Conclusion

The paper concludes that economic tunnel sizing should be guided by the balance between hydraulic efficiency and construction expenditure rather than by hydraulic performance alone. The methodology provides a practical decision tool for tunnel design in Albania and comparable regions. The conclusions are fully supported by the analysis and emphasize policy-relevant insights. The work represents a meaningful contribution to hydropower engineering, infrastructure optimization, and sustainable resource development.