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Counterintuitive Response of Long Circular Tubes to Axial Impact

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The dynamic transition from progressive buckling to a global bending collapse of a long circular tube subjected to an axial impact is studied in relation to its energy absorbing capacity. A tendency to increase the critical length, which marks the transition, is observed when raising the impact velocity but this increase depends also on the striking mass. The analysis reveals a specific impact velocity associated with the geometric and material properties of a tube, which causes a counterintuitive response. It is shown that a predictable initiation of buckling can be obtained for impact velocities away from this critical value, which is only a necessary condition since sufficiently large impact energy can cause a switch from progressive buckling to a global collapse. An empirical criterion for the lower and upper bounds to the critical lengths for buckling transition is proposed based on the theoretical analysis of the buckling phenomenon.

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