Direct Central Impact: Velocities After Collision

Velocities of two bodies after a direct central impact from masses, initial velocities and coefficient of restitution, with energy lost and impulse.

Method: Meriam and Kraige; Engineering Mechanics: Dynamics; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass 1	2.0000	kg
Velocity of 1 before	5.0000	m/s
Mass 2	3.0000	kg
Velocity of 2 before	-1.0000	m/s
Coefficient of restitution	60.000	%

Calculated results

Parameter	Value	Unit
Velocity of 1 after	-0.76000	m/s
Velocity of 2 after	2.8400	m/s
Kinetic energy lost	13.824	J
Impulse on body 2	11.520	N·s

Notes for this case

- Momentum is conserved; e = 1 is perfectly elastic, e = 0 perfectly plastic (bodies move together). Impulse in N·s.

Formula and method

$$v_1 = \frac{m_1 u_1 + m_2 u_2 - m_2 e(u_1 - u_2)}{m_1 + m_2}, \quad v_2 = \frac{m_1 u_1 + m_2 u_2 + m_1 e(u_1 - u_2)}{m_1 + m_2}$$

Variables

m_1	Mass 1	kg
u_1	Velocity of 1 before	m/s
m_2	Mass 2	kg
u_2	Velocity of 2 before	m/s
e	Coefficient of restitution	-
v_1	Velocity of 1 after	m/s
v_2	Velocity of 2 after	m/s
ΔE	Kinetic energy lost	J
J	Impulse on body 2, in N·s	N·s

Method and standards

Momentum and restitution.

Assumptions and limits

- Direct central impact; smooth bodies; body 1 approaching body 2 ($u_1 > u_2$).
- The impulse is always in N·s, whatever the unit system.

References

- Meriam and Kraige
- Engineering Mechanics: Dynamics

- 8th ed. (Wiley, 2015)
- ch. 3 (impact)

Report details

Report reference	FCC-SF9G-EART (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/statics-dynamics/collision-restitution

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.