EQEN

SEISMIC DESIGN OF CANTILEVER RETAINING WALLS

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PROBLEM

There is no computer code available for use by district engineers in the seismic design of cantilever retaining walls that follow the Corps engineering procedures for these structures.

OBJECTIVE

- **To implement the Corps engineering procedure for the seismic design of cantilever retaining walls in a windows-based computer program, named CSLIP, to be used by district engineers.**

EM 1110-2-2502

Static Loadings of Cantilever Walls

DESIGN OF RETAINING AND FLOOD WALLS

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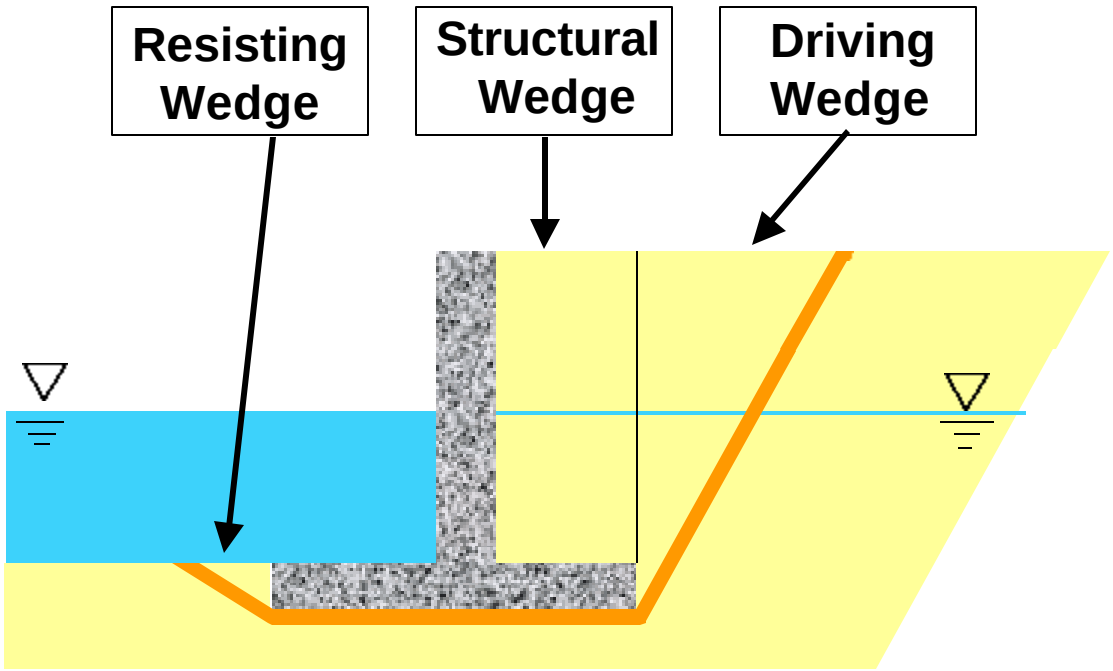
CTWALL

CTWALL

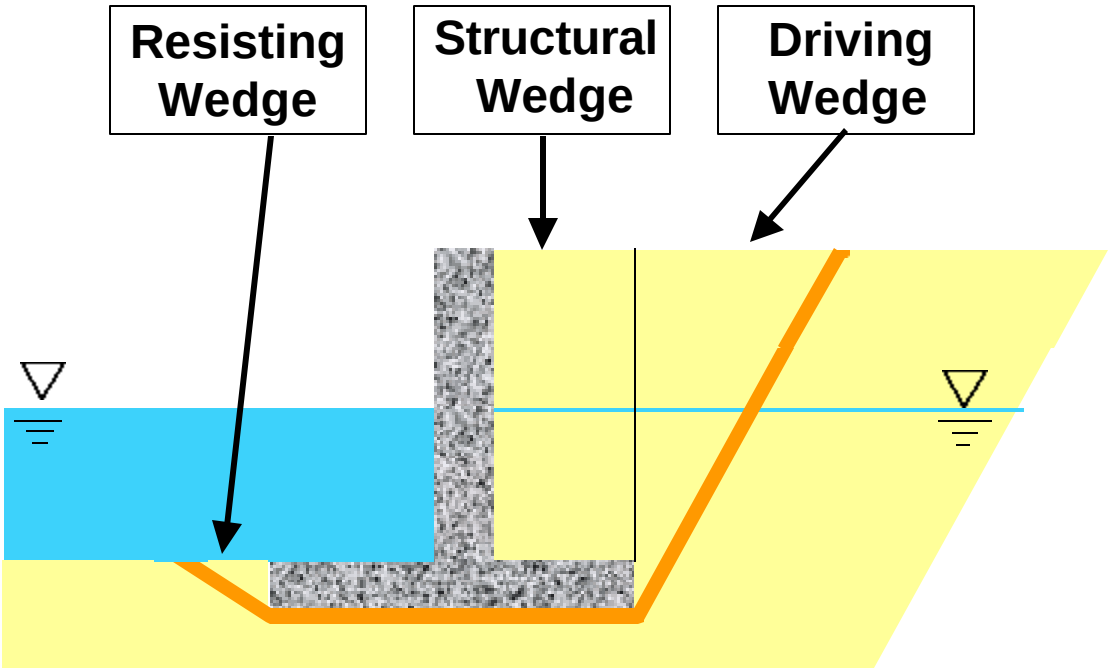


STATIC DESIGN

CTWALL

- CASE computer program used for the design of cantilever retaining walls by district engineers.
- Follows the engineering procedures given in Engineering Manual 1110-2-2502, Retaining and Flood Walls for Static Loadings.
- Used to size the walls and to compute the earth pressures and bearing pressures to be used in the design of the steel reinforcement.

CSLIP



SEISMIC DESIGN

CSLIP

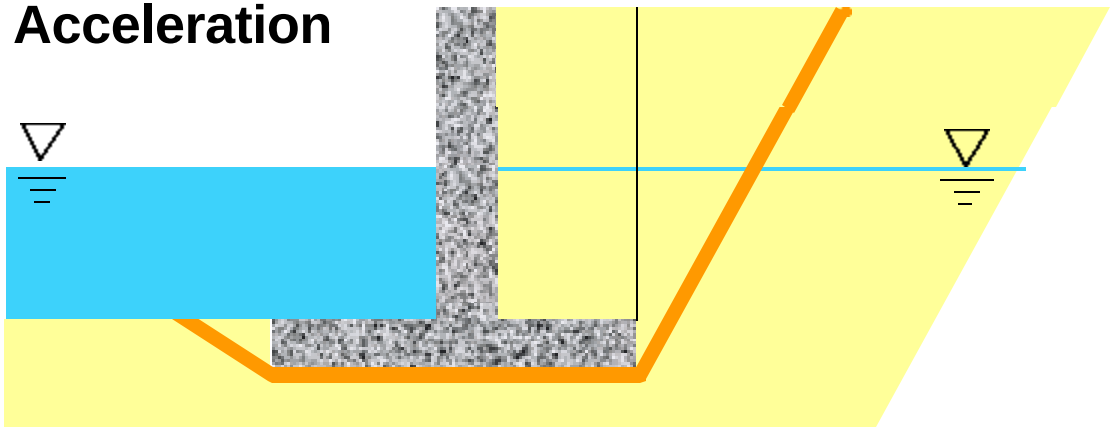
The essence of the seismic design procedure for cantilever walls will be based on the seismic displacement method of analysis.

DISPLACMENT CONTROLLED APPROACH

A procedure for choosing a seismic coefficient based upon explicit choice of an allowable permanent displacement.

N*g

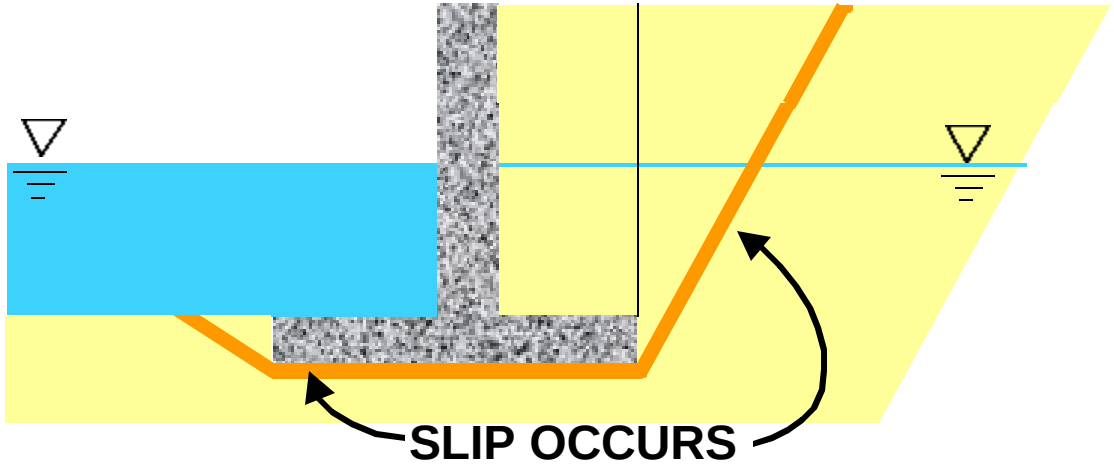
Maximum Transmissible Acceleration or Yield Acceleration



Limiting Acceleration Resulting in FS_{SLIDE} = 1.0

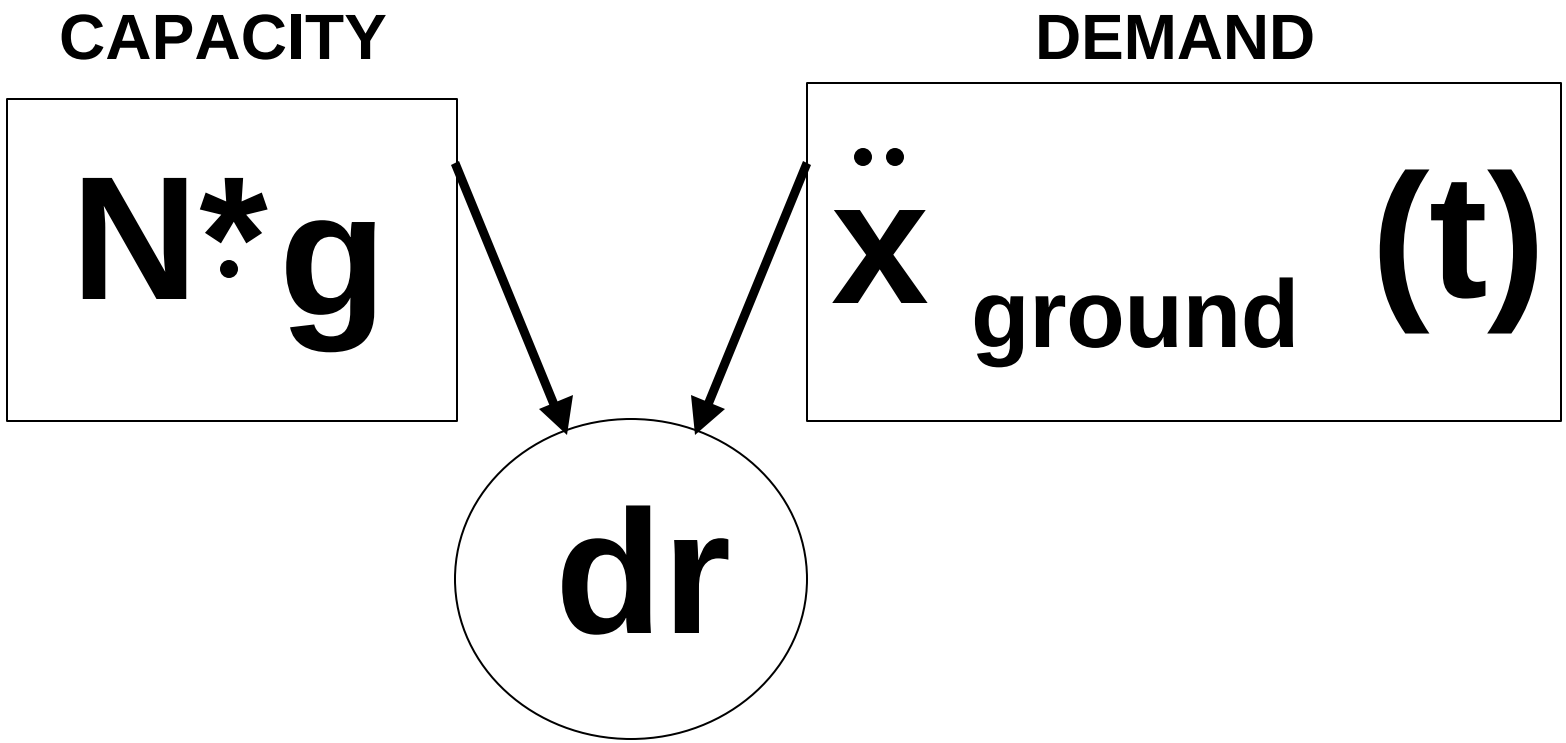
CSLIP

WALL AND FAILURE WEDGES TREATED AS A SLIDING BLOCK

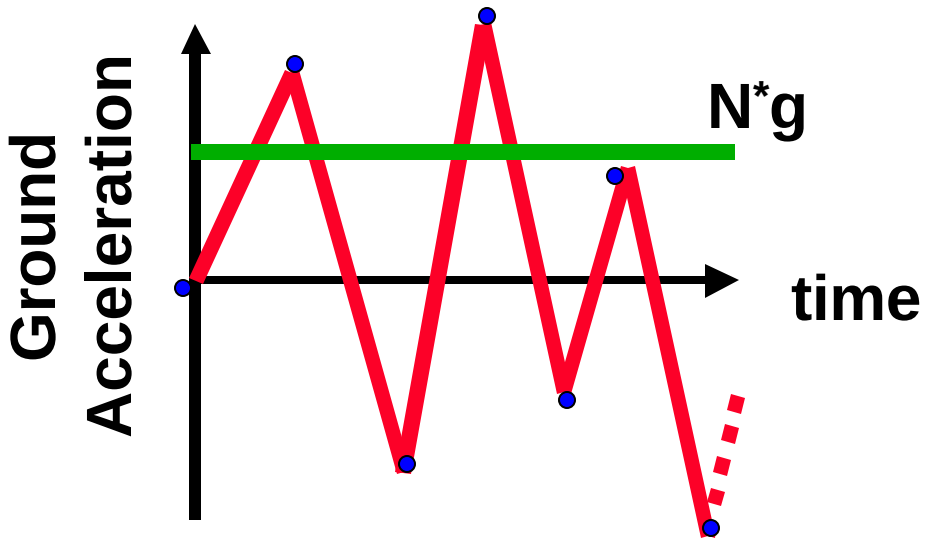


SLIP OCCURS WHEN $\ddot{x}_{GROUND}(t) > N^* \bullet g$

Permanent Seismic Displacement
dr



INTEGRATION OF THE ACCELERATION TIME HISTORY



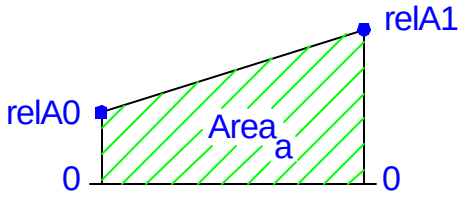
Relative Acceleration = Ground Acceleration -N*g

Numerical Integration based on assumption of linear acceleration between timesteps.

Acc. values at DT time increments.

Known	Unknown
relA0	relV1
relA1	relD1
relV0	
relD0	

Relative Acceleration (Linear)

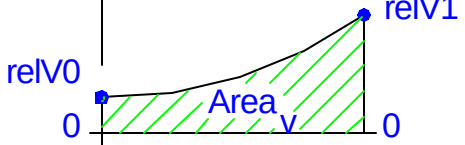


$$Area_a = \left(\frac{DT}{2}\right)(relA1 - relA0)$$

DT

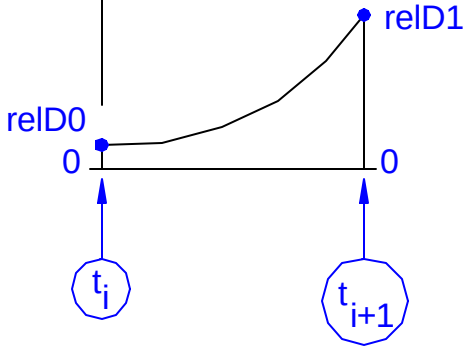
$$relV1 = relV0 + Area_a$$

Relative Velocity (Quadratic)

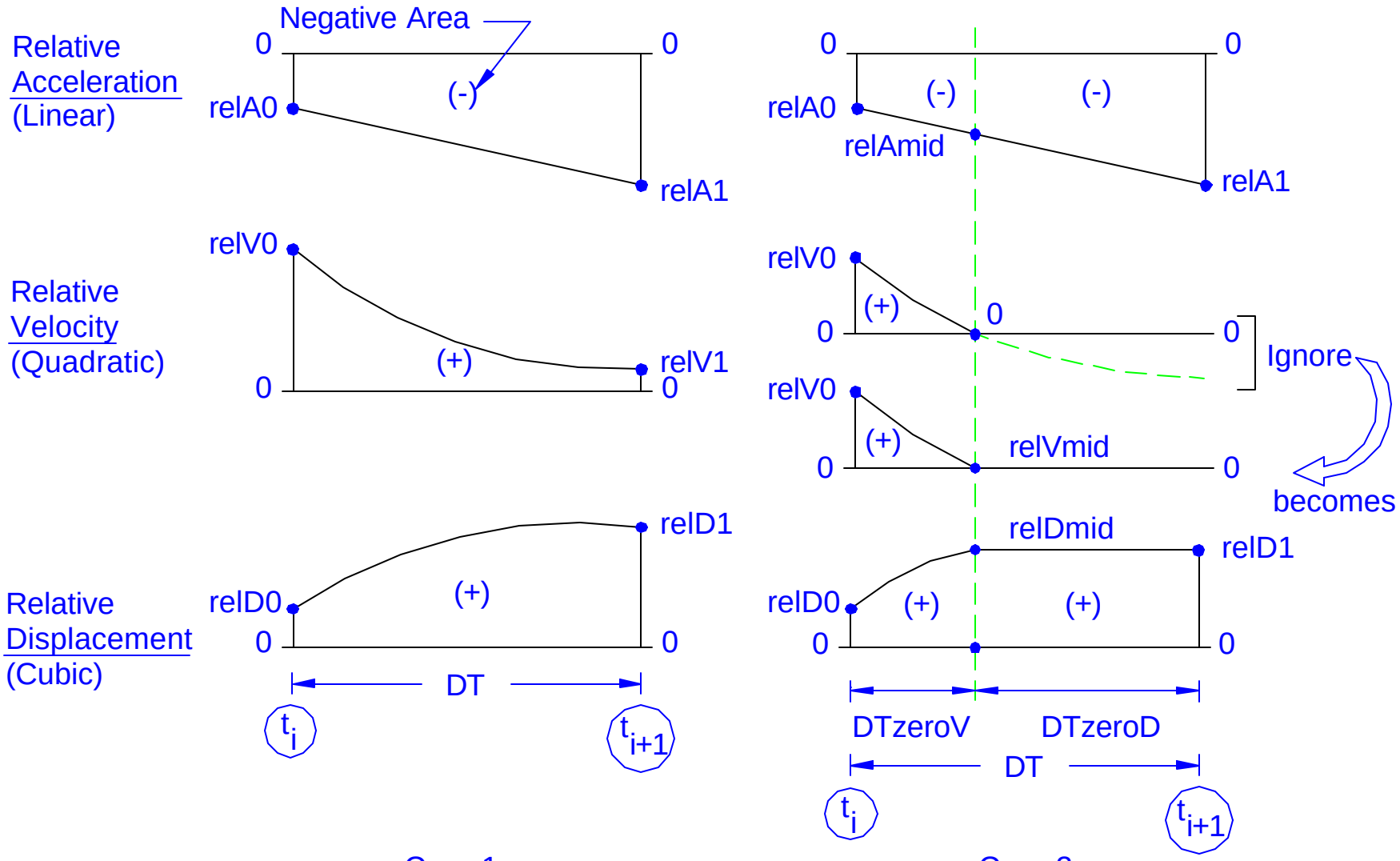


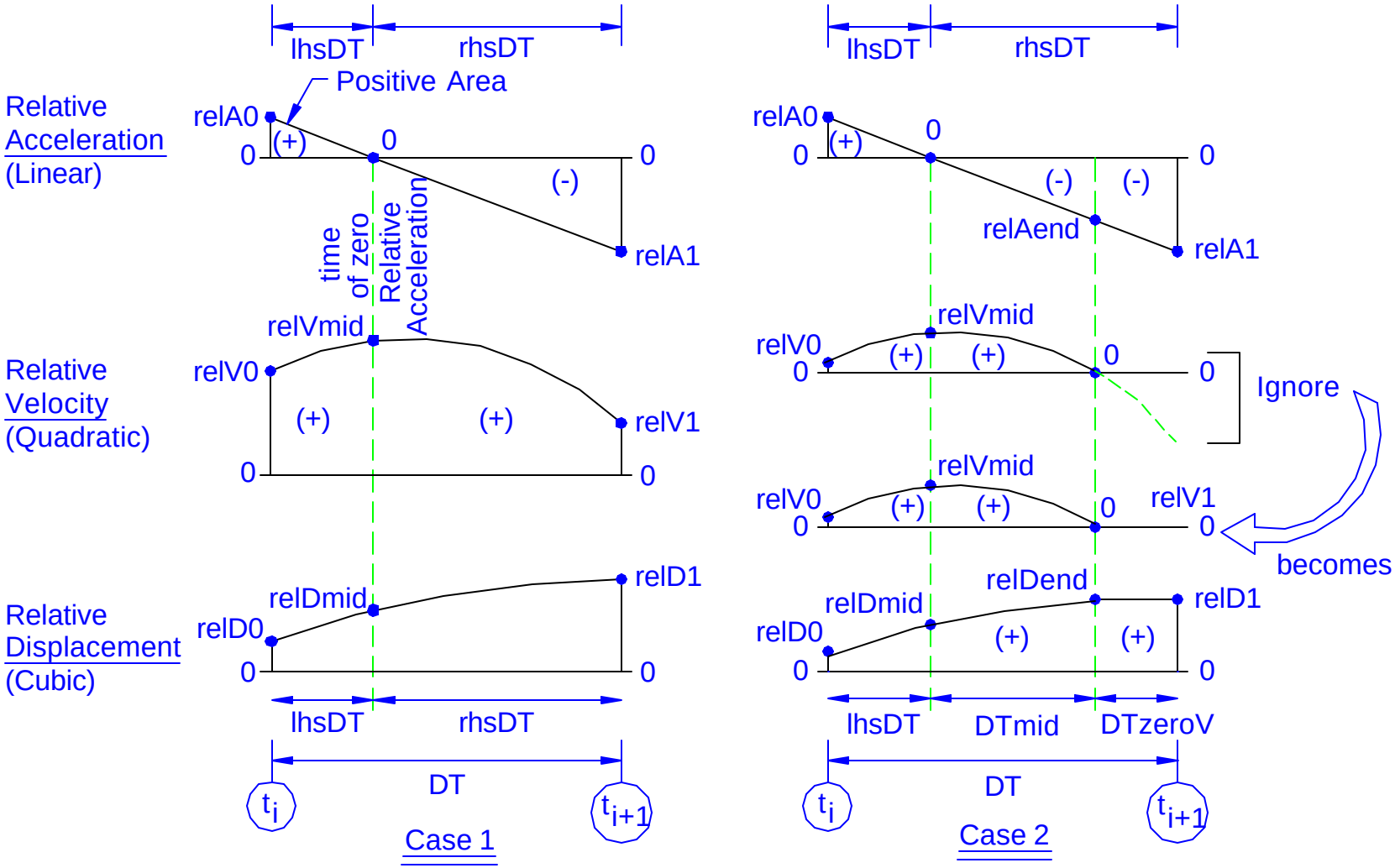
$$Area_v = (DT)\,relV0 + \left(\frac{DT^2}{6}\right)(2relA0 + relA1)$$

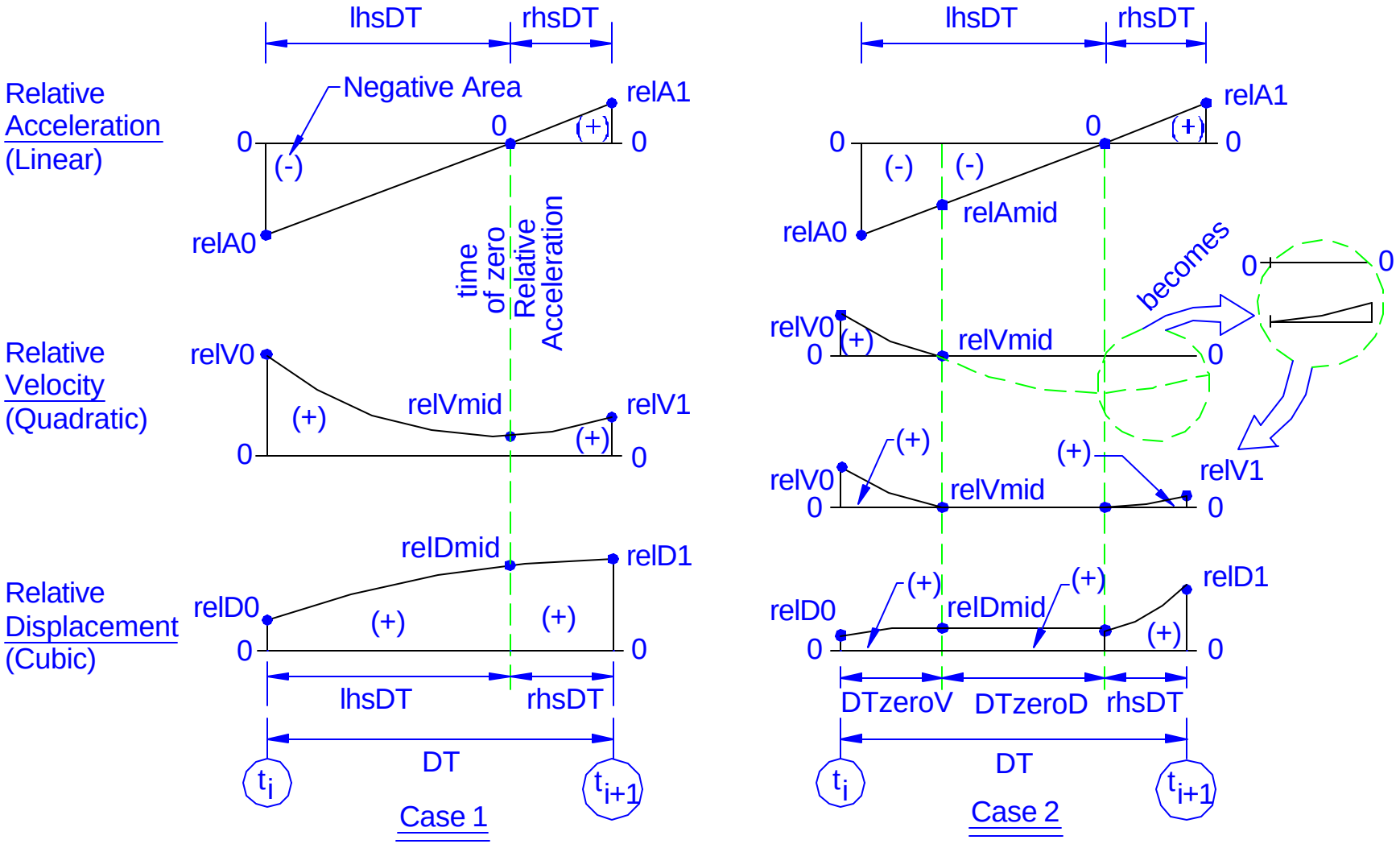
Relative Displacement (Cubic)



$$relD1 = relD0 + Area_v$$


Relative
Acceleration
(Linear)
Negative Area
0
0
relA0
(-)
relA1
relV0
Relative
Velocity
(Quadratic)
(+)
relV1
0
0
relD1
relD0
Relative
Displacement
(Cubic)
(+)
0
0
DT
t_i
t_{i+1}
Case 1
0
0
relA0
(-)
(-)
relAmid
relA1
relV0
(+)
0
0
0
Ignore
relV0
(+)
relVmid
0
0
becomes
relDmid
relD1
relD0
(+)
(+)
0
0
DTzeroV
DTzeroD
DT
t_i
t_{i+1}
Case 2


lhsDT
rhsDT
Positive Area
Relative Acceleration (Linear)
relA0
0
(+)
0
0
(-)
relA1
time of zero Relative Acceleration
relVmid
Relative Velocity (Quadratic)
relV0
(+)
(+)
relV1
relDmid
relD1
Relative Displacement (Cubic)
relD0
lhsDT
rhsDT
DT
t_i
t_{i+1}
Case 1
lhsDT
rhsDT
relA0
0
(+)
0
(-)
(-)
relAend
relA1
relVmid
relV0
(+)
(+)
0
0
Ignore
relVmid
relV0
(+)
(+)
0
relV1
0
becomes
relDend
relDmid
relD1
relD0
(+)
(+)
lhsDT
DTmid
DTzeroV
DT
t_i
t_{i+1}
Case 2


lhsDT
rhsDT
Relative
Acceleration
(Linear)
Negative Area
relA1
relA0
0
(-)
(+)
time
of zero
Relative
Acceleration
Relative
Velocity
(Quadratic)
relV0
relVmid
relV1
Relative
Displacement
(Cubic)
relD0
relDmid
relD1
DT
t_i
t_{i+1}
Case 1
relAmid
becomes
DTzeroV
DTzeroD
Case 2