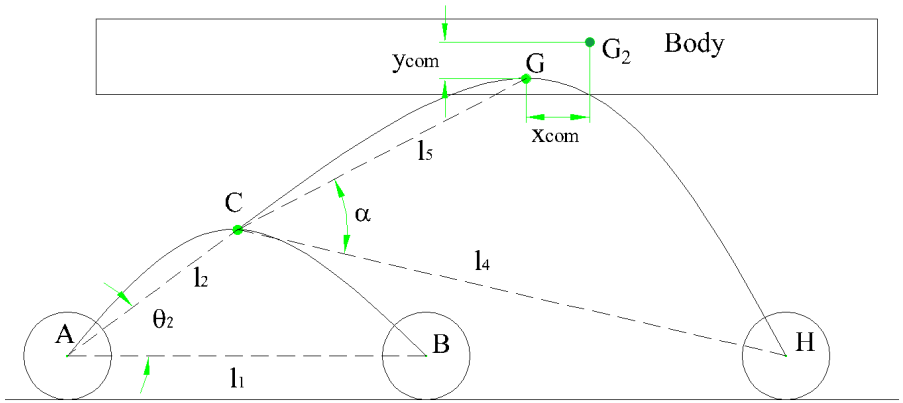
Optimal design and operation of Rocker Bogie suspension for minimum μ required

Objective function: Minimize (μ)
Subjected to:

- Equality Constraints
  - equilibrium equations (6 X 15 poses= 90 constraints)
  - the centre of mass of the payload is at the pivot point 'G', (2 constraints)
- Inequality constraints
  - Slip constraints ($-\mu R_i \leq N_i \leq \mu R_i$) (90 constraints)
  - Overall length constraint (1 constraint)
  - Height of the Body pivot (1 constraint)
  - Rear wheels are not allowed to intersect with the step, which will happen while the middle wheel climbs the step (5 constraints)

Results of Optimal Mechanism

Design variable	Before Optimization	After Optimization
l1	0.2812 m	0.2475 m
l2	0.2012 m	0.1758 m
$\theta 2$	0.6310 rad	0.3458 rad
l4	0.4175 m	0.3251 m
l5	0.125 m	0.1648 m
α	1.2158 rad	1.4764 rad
Xcom	0	0
Ycom	0	0
μ	0.6095	0.4568



Checking Optimal solution

- Optimization done in MATLAB, 'fmincon'
- Solution obtained need to be checked for KKT conditions
  - Any constraint is violated , if not
  - Find all active inequality constraints, lower and upper bonds of variables
  - Find lagrangian multiplier to satisfy $A\lambda = \bigtriangledown f$

where A =gradient of active set of constraints and bounds

$\bigtriangledown f$ = gradient of objective function

λ = Lagrange multiplier Check whether λ of inequality constraints are negative

λ range from 0 to -0.2650

Active inequality constraints = 24

Active lower bound= 1

Active upper bound=0