Abstract

This study deals with the solution of the optimization of reinforced concrete one-way ribbed slabs. The optimization problems are solved using genetic algorithms (G.A) and simulated annealing (S.A) optimization methods.

The objective function is taken to represent the cost of materials (concrete and steel reinforcement), and formwork. The design variables of the problem were taken as; slab thickness, spacing between ribs, lower width of ribbed, upper width of ribbed, depth of rib, depth of beam, shear reinforcement spacing for ribs, bar diameter and spacing of top slab, depth of the neutral axis from bottom fiber, beam width, and areas of flexural reinforcement at critical section of bending moment along ribs and beams. The constraints include limitations of the joist construction constraints stated by ACI-Code-14, the top slab thickness to satisfy fire resistance, the steel reinforcement areas that satisfy the minimum reinforcement area requirements, and the total slab thickness that is enough to satisfy deflection requirements and flexural behavior.

The result conclusions can be drawn from this study for the one-way ribbed slabs cases that ratios to get optimum solution considered showed in this Table:

Ratios	G.A	S.A	Note
Change the span length(4-12)m with constant other data			
Total slab depth/span length	(1/18-1/4)	(1/18-1/5)	The deflection requirement that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(1.2-2.9)	(1.3-2.78)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/4-1/2)	(1/5-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)
Change the concrete compressive of Strength (25-55)MPa with constant other data			
Total slab depth/span length	(1/9-1/7)	(1/11-1/7)	The deflection requirement that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(1-2.674)	(1-2.635)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/4-1/2)	(1/5-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)

Ratios	G.A	S.A	Note
Change the live load ($2kN/m^2$-$7kN/m^2$) with constant other data			
Total slab depth/span length	(1/9-1/4)	(1/11-1/6)	The deflection requirement , that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(0.99-3.3)	(1.15-2.8)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/3-1/2)	(1/4-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)
Change the unit Cost ratio (concrete cost/steel cost)=(0.1-0.35) with constant other data			
Total slab depth/span length	(1/4)	(1/7-1/5)	The deflection requirement that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(2.4-2.5)	(1.9-3.19)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/2)	(1/5-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)
Change the aspect Ratio (long span/small span)=(1-2) with constant other data			
Total slab depth/span length	(1/10-1/7)	(1/12-1/9)	The deflection requirement ,that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(1.2-2.65)	(1-2.7)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/6-1/2)	(1/6-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)
Change the cost Formwork(10,000-22,000)(I.D) with constant other data			
Total slab depth/span length	(1/9-1/4)	(1/10-1/5)	The deflection requirement, that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(1.07-3.5)	(1.14-3.3)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/5-1/2)	(1/3-1/2)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)
Change the steel yield strength (420-600)MPa with constant other data			
Total slab depth/span length	(1/10-1/8)	(1/11-1/8)	The deflection requirement, that ratio is to be equal or greater than(1/18.5)
Depth of rib/lower width	(1-2.3)	(1.1-2.3)	Joist construction limitation stated that the ratio should equal or not be greater than (3.5)
Slab thickness /spacing of rib	(1/6-1/3)	(1/6-1/3)	Joist construction limitation stated that the ratio is to equal or greater than (1/12)