The Role of Roof Truss Construction in Optimization Structure

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Abstract

In order to make an efficient roof structure, it is important to take in to consideration main factors in which effect the stress, stability, and weight for overall construction. In this paper the essential factors that introduce in the design and implement the structure and examine all forces, torque and inertias in which optimize the roof truss. Usually, to improve structural optimization design efficiency for truss implementation structure factor is the weight. Reduce of weight contribute to maintain the material, in other words the structure shall use little amount and number of elements, welds joints, and external surface area, so theuseful optimizecase usedseveral approaches in many mathematics fields.

Keywords:-Optimization structural, Roof truss construction, Dynamic constranint s, Effective useful topology.

1. INTRODUCTION:

Truss structural optimization comprises continuous optimizingfor sizing, outer shape, and method of finalizing; the preliminary approach for synthesis and optimize, that locatedloads ofthe desire one, that not always possible depending onmore economical design solutions. The optimization processes by pioneer engineers to achieved the logical or require remembering of analysisbases.

Future proposedmethods for looking for best approach has attractextreme sense due to large optimize one;the objective is to evaluate solution for the problems easy to encounter the local optimization[1].

The structure optimization is main enter counter problem that faces most scholars since along time, mechanics,structural optimizekinds in which putting together in final criteria optimize the required structure. Several factors dedicated in the mechanics requirement, like project factors are involved in optimize modifications in engineering structural for availableones that means the more solution in certain case may be evaluated in more than one solution[3].

Practically, applications deems to be optimization procedures to enlarge significantof multiple aspects construction in whichthe each constranint which is added to avoid unwanted criteria's. Minimum weight is still optimize generally approached through either in sizeby modifying cross sectionalarea or bar alignment), or by varying the shape i.e. the position of joint points), finally the method of add or removecertain elements in between joints) [2].

One of the combinations, constranint s range of search the spacesbetween maximum allowableloads, and maximumpreferable displacement which in general found literary;in order tomaintain construction steadying for case of unstable constranint s must also be implement.

2. OPTIMIZINGTHE TRUSS FIXTURE IN CASE OF STEADYCONSTRANINT S:

The acceptable and applicable geometry used for obtain the required optimization into existing topology optimization procedures in case of truss structures with steady constranint s;first of all assumethe design comnmentary in selected area and the type of fixture allowed for joints; that makes the optimization problem formulations difficultly unordinary in which achieve definite programin adequate, where the limited available numericfounder with respect to other cases of optimization. the present problem of truss method for deal optimizing with highly steady constranint s useunique primary double inter point implement [3].

Further, the solution for both cross-sectional areas and fixture of the joints are surly optimized. Then, applying adequate optimizedtechnology to evaluate the points in which larger move limits in the minus form for improvingoverall design.

The method of topology optimize procedures comprise multi math- process and programs to satisfy and evaluate the optimal mateoutput with in required approach, of the same variable load, asympto condition, different cases an objective to enlarge and efficient overall system performance.

This method differthan view optimize and size calibration which so called modifying in the case may attainedat certain view for allowable approach range, rather than that in which deal with pre-defined [4].

The main topology optimizein which usecertain method of F.E.M,to calculate approach leadership; in which need to optimized via gradientbase math programming altered, optimal criteria algorithm,method of move asymptotes, even non gradient base algorithm[5].

This approach has variety applications in certain fields; Recently, the specialist staff usually take a glance for topology optimizeunder the main approach procedures.

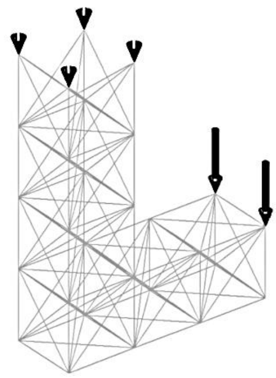
In our work, an ordinary regional truss has been optimize size, external view, its simultaneous association. A program has progresses the purposeby usealgorithm optimize in which comprise stresses, displace, and limitedconstranint s via split cross-sectional area, and variables calculationto the outer surface of the optimum truss.

So that; as we notice, any surface connection for the modulating structure for the required example of truss may contain a huge part in the complete construction for the outer surface, as a consequence the perfect design in which we aim is overcome with the design criteria, that means reduce the spaces between structure bars and attempting to reach the optimal complete design in which satisfy the adequate and appropriate results [6].

The optimum practical is dedicated by remove the certain connections of bars in this optimize than truss don't applicabl because of mechanical; the topology optimize is not always applicable. where the always public object func. of truss structue optimize is minimize weight procedures. The min. weight design statistic defined in Eq. (1) in which give the essential constrains use in truss structure optimal.

The truss structure optimizecomprise simultaneous optimize of size, view. This is not always allowable dependthe primary design of truss be optimizethan practice fitting of location and loadthese joints[7].

where optimize constranint considerfor the main alyewas for obstruct intend surroundin many cases that should maintain the overall elements like node;optimize depend on the structure stability of the construction[6].



(a)

Fig.(1-a): The optimal structural design for truss management

In case of single rotating bridge, as seen at fig. (1) below, which enhancement in the end to end elements on the threshold. The synthesis view serve each of meters of 15×1.25×1.5,which applied forces of (0,0,− 0.003)approximately;also bars compliance on which set to ς =0.065;the objective is to evaluate, solve, then obtainthe optimal designs in the same case shown.As noticed, the final design obtained has a least volume than that of beginning solution (Fig. 1-a),

The final optimal wave creteria seen above at fig. (1-A); we have two great comparable semicircle design fixture on both ends, further at a smallcompare semi-curveat the mid of structure [8].

3. GROUP PREDATION BEHAVIOR:

The best and the due to swing in the global that concern withgeneralabove weight human viewed like making steel, then the make a sinousoudal narrow best method. That because both in groupas anobvious divework. Someone who make this evaluate to provide direction the all popule, where the remainto maintain his own as a result of obtained one. The most populateto being realizethe as an undertaking in comes,stars publication of backside environment [9].

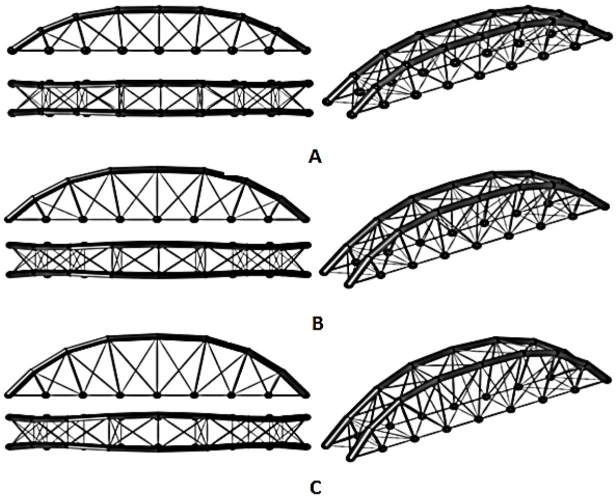


Fig.(2): The main vol. for each case in optimization truss structure in three cases and applied loads, (a), (b), (c) has volume equal to 5.5, 4.9, 4.7 respectively.

Researchers and developer, intelliger optimize algorithms like Michael, et. al, in which proposedevelop the work by using certain algorithm based on chos principle, in which applyspecially for truss structure to verify effective of improve algorithm in this case truss engineer structure optimize [9].

Also Christian, et. alexplorethe recent intelligentone, that discussed practical applications in the field of civil, mechanical.

In the field of civil engineering, the second algorithm applyfor the alignment of 25-bar truss structure to optimal case, also feasibility of this approach was examined [11]. B. Wang et al. proposed a multi particle new one algorithm based on the develop of previous algorithm such as (SDD).

The improved one choice a partition of unlimited simplex substance for optimize, by useenergy modal as shown in Eq.(1):

$$MSx_d^t(i) = r_1 \times x_d^t(i) + (1 - r_1) \times x_d^t(j) + c_1 \times x_d^t(i) - x_d^t(j) \; \ldots\ldots. (1)$$

$$MSx_d^t(j) = r_2 \times x_d^t(j) + (1 - r_2) \times x_d^t(i) + c_2 \times x_d^t(j) - x_d^t(i) \; \ldots\ldots (2)$$

Based on the above research, this paper improved the ch. swarm optimize and apply to truss structure develop case; the concept of combining chaos strategy and reverse learning strategy was introduced in the initialization to ensure the global search ability. And the inertia weighting factor and the learning factor were introduced into the chick position update process, so as to better combine the global and local search. Finally, the overall individual position of the algorithm was optimized by the differential evolution algorithm. The improved algorithm was tested by multi-peak function and applied to the truss simulation experiment. The best result in which could obtain is the findings are shown below, as shown in Table (1), below.

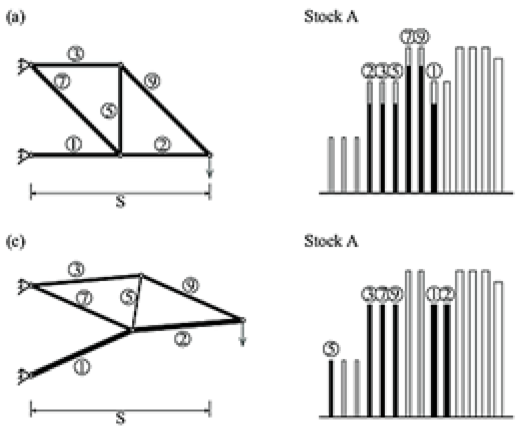
Order	Vol.	Computer findings
1	3.14	1983
2	3.32	1341
3	3.65	1476
4	3.47	1587

4. ALGORITHM DESCRIPTION:

It is difficult to solve the stated, expected non-linear semidefinite program truss geometry and topology optimization problem. Additionally, by setting the radius of the motion confined to a permissible number, the problem is usually and always solved, mostly because short bars are avoided[12]. Applying an adaptive optimize process will then allow for design improvement. There were certain instances, mostly in the adaptive optimize's last stage, where the problem was difficult to solve because short bars were unavoidably present (2-b,c).

However, it can be successfulfor resolve use a significant less aggress update strategy of the best parameter and to conservative next step lengths, at the period of more iterate; to notice the results in table (1). As a last comment; also important that these joints are constrained to always remain within the prescribed restricted regions (2) and (3), both initially and in subsequent iterations.

The joint is allowsto change the selected space limited accesss with stand election designedas in fig. (3-a). where to be able so like selected conditions and boundaries as in fig. (3-b)where the fixed 12.54, remain eight percent less than the original one who found in the previous method as in fig. (3-b,d). So, the obvious one in which calculated like the final results obtained in the next and second element geometry; the elements are choice instead of the optimal one who equal to 0.53, since the barriers elements internally should being at the surface require to maintain as view in fig. (3-a,c).



At this position, obtainationselected one as in fig. 2-b,so the vol. of 5.87, that approximateof (17 percent) fit of fix elements solveas mentioned fig. 2-a;It so, seen in fig. 2-c, where several joint that findings line then leave to the originones automatically, as shown in (fig. 2-c), like the overall externaspect of the optimize structure now appears curved formyl [13].

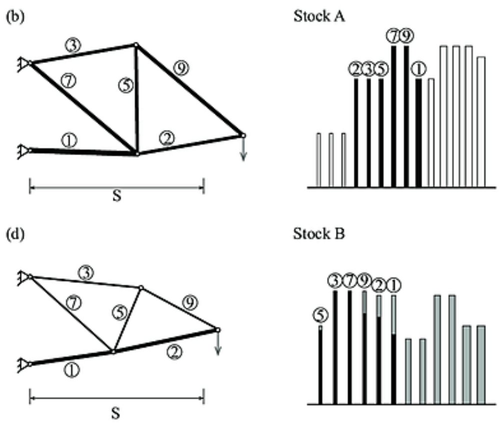


Fig. (3): Resultant scheme for the three cases in nodes orientation

The following flowchart obtained from the best solution that grams from above assumptions, in which the set of values depend on the application of selected parameters according to the generalize opposition. So the horizontal crossover strategy by Eq.(2) and the vertical record optimal value and the worst one. The procedure still until meet the termination conditions.

The flowchart below showed the steps that depicted for the estimate cateserbie more than nodes alignment [10].

The solve topologiest optimizecomplications in a split done was create via discretizethe overall range into selected method. The value in which cretcise materialsstuffes in these elements are then treated as the problem variables. In our basic phenomena the stufness for certain one pointed to the existing of the same, where the nil found in which refer to an overcome the desired thing.

So, the attainess perfection difficulties such that been dependupon the amount certain thing, for example huge amount of preferred cores. These, huge amount of selected points in which calculated under the integration due increasethe selected ones difficulties, so it may affect the price also[14].

In the beginning, make solution for these selected elements and putting its in form of matrix,to become more effective;then, the depicted method we can deal with these huge amount may define the most split unconstant elements with many constranints availablely. Further, it impracticalies sension to elements changing[11]

$$F(x) = \begin{bmatrix} f([x_{1,1}\ x_{1,2}\ \cdots\ x_{1,d}]) \\ f([x_{2,1}\ x_{2,2}\ \cdots\ x_{2,d}]) \\ \vdots \\ f([x_{n,1}\ x_{n,2}\ \cdots\ x_{n,d}]) \end{bmatrix} \ldots\ldots (3)$$

where, among them, $x_{n,1}$ represents the dimension of the problem to be optimized, and (n) represents the number of iteration population needed;then, the fitness value of all measures can be expressed as:

$$\begin{bmatrix} x_{1,1} & x_{1,2} & \cdots & x_{1,d} \\ x_{2,1} & x_{2,2} & \cdots & x_{2,d} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n,1} & x_{n,2} & \cdots & x_{n,d} \end{bmatrix} \quad \ldots\ldots (4)$$

Among them, the function (f) represents the value of desire function; so the discoverer with better result will obtain earlier in the search process.Since the discoverer needs to guide the foraging direction for the entire population, the discoverer can obtain a larger food search range. In the iterative process, the flowchart needed for obtain the result found in and represent in the Eq. (4)

5. CONSTRANINT S THE MEMBER STRESS:

The constranints comprise the member stresses loads, node displace, and buckl strength;concern the member stress, the results from design load combine within allowable limits, in accordancewith the materials used;were the number of functions determined with regard to allowable tension and compressive stress for truss members[13].

The inequality constranint s were normalized and a slack variable introduced to each of the constranint s. This automatically scales the constranint making it easier to be handled. Eq.(3-5), the application of the scale factor and the slackness property of the constranints.

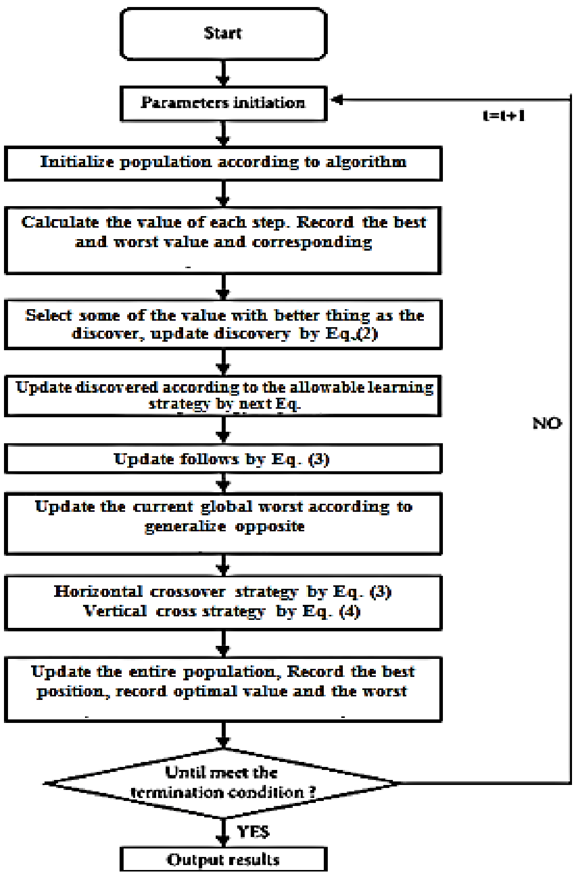


Fig. (4) : Flowchart for the more than one nodes exist in the truss structure

Every acrote that constrants will rise the difficulty of the object put the evaluation of international options which most puzzled; then putting the additioan motive constranints like field bucklbecom un even so biggross pad; thisconstranints is to be considemovable as they could create in every period optimizeso that crossal may changein chaning the croatia, and the change of shape changes the length of elements;the changes as well as shape changes

Again, for the gross design criteria, steady status and equilibrium for the overall structure occur, while different cases of forces bars and beams inside the design work and behave as a unique build; that optimal imagination require certain algorithm to apply, further the linear and non-linear assumptions can be handle for this large amount of elements which represent the perfect method should be applied to obtain the favorable approaches like capability of satisfy stress and steady cases in many variable conditions [12], as we notice in the terms and elements substitute in the following equation:

$$Minimize\ (\rho) \qquad F = F(u(\rho), \rho) = \int_{\Omega} f(u(\rho), \rho) dV$$

$$Subject\ to \qquad (\rho) = \int_{\Omega} \rho \mathrm{d}V - V_o \leq 0 \ldots\ldots \quad (5)$$

$$G_j(u(\rho), \rho) \leq 0\ with\ j = 1, \ldots\ldots, m$$

The above equation representation for the cross sectional for all elements which gathered in to more than one and different groups symmetrically obtainable;thenthe cross-section profile groups are as follows: $A_{(1\text{-}1)}= A_{(1\text{-}2)}$, $A_{(2\text{-}1)} = A_{(2\text{-}2)}$.

These groups are made to avoid solutions with changes in cross-section along a line of elements which are in arranged in series which would require additional critical load parameters. One square profile was use in list of discrete size variable for cross-section profile accord to table. For members under compression, the value of should be determinewhether the appropriate non-dimensional slenderness ratio from the relevant buckling curve, according to Eq. (5).

$$x = \frac{1}{\varphi + \sqrt{\varphi^2 - \lambda^2}}; x \leq 1$$

$$\varphi = \frac{1}{2}[1 + \alpha(\lambda - 0.2)\lambda^2] \qquad \ldots\ldots (6)$$

$$\lambda = \sqrt{\frac{Af_y}{N_{cr}}}, \qquad \sqrt{\frac{A_{eff} f_y}{N_{cr}}}$$

Where,one term is depicted the cases crosses sectional, while the next one is concern the fourth parts. Further, *A*represent reducingelement of relevant creteria, where first term in (6) is applied for same cases mentioned above, the next one belongs to rather than, also $P_{cr}$is the probability of elasticity for new case load,with respect to total secional area c/s. So that, in order to achieve the optimization case, for our selected design, ought using the method of removing for the non-horizontal structures, that control the huge mechanism, that occur in many choices. Now we aim to examine one of the most used criteria as obvious in (fig. 3) the selected tested groups are (c, d).

5. RESULTS :

Most of the evaluation and optimizeconcern the view and simultanusto gathered of view, by using the essential program in which progresses later.

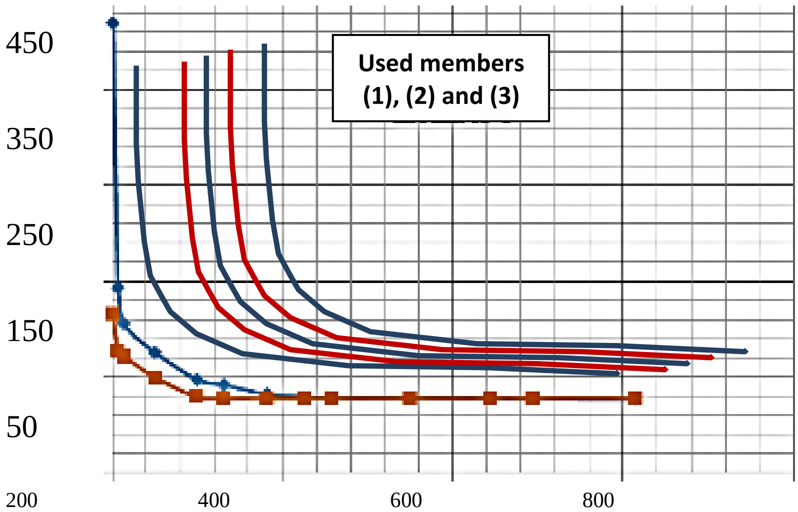
The optimizedirect useis certain method called as a base of favorable c/s for three cases in our estimated phenomenal.

Mem.	Length (cm)	Area of section (cm2)	Area od discrete section (cm2)
1	376	214.76	265
2	376	210.54	249
3	376	118.43	198

Mem.	Length (cm)	Area of section (cm2)	Area od discrete section (cm2)
1	398	236	277
2	398	251	261
3	398	298	222

Mem.	Length (cm)	Area of section (cm2)	Area od discrete section (cm2)
1	411	215	241
2	411	218	237
3	411	221.6	232

The chart of maximum displacement measured in (mm), vs the cross section area measured in cm^2), the members in which used and examined in this section is both member (2), and (3), as shown.



The applied loadsused, and equivalentstresses for each case are 970, 990, and 1125Kg. where the optimal design for the truss structure is obvious in third test, even higher load applied.

6. CONCLUSION:

The most concern structures truss a serious think, so the design requireto several altitude, remarks and factors affected, like enormous constranint which are apply within overall calculation to be off minimum;thus, truss structures are either two dimensions (planar) or three dimensions (spatial) depend upon structurebasily exist as most engineering fields, like this matches could be able to use these brands in many other cases. These structures comprise many of dex-connection,in which undertake all pressures, top torques, and also most forces in around; further to multi other forces was needed.

Many structures mostly failstrongly, when allcalculated loads and limits are taking in to account. Practicaly, most reliable structre failcases, that based essentiallyloding more than internal capacity, this case calledevaluating the most favoraible one who entrcounter the needed encounter the field engineers for objectives dedication and tacking in to consideration.

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