THE ASSESSMENT OF BEHAVIOR OF CONCRETE ARCH SHELLS UNDER UNIFORM DISTRIBUTED LOADS

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Abstract:

Arch shells have vast application in Some grounds such as: civil engineering, mechanic and in building bridges, tanks, cover of large spaces, industrial storages, construction and etc. One of reasons to mention for deployment and using of these structures is its economical design in light of materials and costs.

In case of arch shells, there are some studies, under aerial loads [1], wind, and dynamic [2], but in this paper, two kinds of circular and original Iranian section under distributed symmetrical loading effect and partly loading are discussed and their results are compared and evaluated. In this way, changes of height, Length span and Kind of loading are studied and resistance parameters of this model are studied. These models for 3 spans with different (12) heights are sealed under spread loading [complete, 25 %, half and 3/4 of length cover with step – by-step loading] and are analyzed in nonlinear by Lusas software.

Resistance parameters, in this study, resistance criterion, bearing potential and plasticity of structures. For this purpose, deformation-load diagram, in point of maximum displacement which was occurred, is drawn and resistance criteria of most load, which structure can bear before breakdown space under the diagram and most placemat which can be resulted from this diagram (respectively) are selected.

Keywords: Arch shells, original Iranian section, circular section, resistance, bearing potential, plasticity of structure

1   Introduction

Shells structures have large application in today's developmental industries, because of essence behaviour and way of bearing entrance loads. These structures, in addition to high and acceptable strength, can contain suitable weight, volume, and cost. Analysis and design ways of these structures have has more development, beside their different and more applications. Arch shells used two mechanisms, flexible with low effect and membrane with more effect[3], for transfer of force. For structural purpose, these kinds of structures are settled under axial stresses[4]. In this paper shells structures with arch section is studied. In this way that at first original Iranian arch sections are recognized that have vast applications and then shells like every one of these arch's which are modelled for

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spans with 35,7,10 meter, and vast loading in complete,1/3, half, 3/4 of span is formed like step-by-step increasing. Then behaviour of each 3 structures are considered in point of view of resistance, bearing potential, and Plasticity. In continue, effect of changing in length of span is studied and each of these parameters and kinds of loading effects are discussed. Then for all of original sections, models of circular shells like that same length of span and height and loading conditions are modelled until to represent suitable model with attention to different conditions. It must be mentioned that base of study of structure resistance is determined in base of highest point in displacement-Force diagram.

This diagram is considered length of changes of load to displacement, of some points that shown most displacement, and bearing potential criteria of space under this diagram and of deformability criteria of most displacements that then sections are shown.

2   How to modelling in lusas software[6,7]

It is over 25 years that finite element method is used for mechanical and dynamical analysis; because save costs in constructing laboratory models and doing expensive tests are saved. Main purpose of in finite element method is finding solution of one complex matter (problem) by replacing it with simplest model. Existing mathematical tools are not enough for finding exact response of more scientific matters. So, for finding approximate response of one matter, we must use finite element method. In this method, this area divide as a small sub- area of linked to each other that called finite elements.

These elements are used in thin-plate element, and two dimensional and eight knots in rectangular shape with abbreviated name of QTS 8. Material is considered in kind of reinforced concrete 84 with 30cm thickness.

3   Loading and Analysis

Loading is determined in case of distributed complete, half, 3/4 and 1/3 of span bye step- by- step in creasing of with initial load e- 3 N/mm2 with increasing amount of each growth of 500 unit, till receive to William breakdown criteria.

4   shape of Models

Because of excess using of this kind of structure. Presentation some of models that can show construction process of this structure is difficult. In this way, according to study of researcher, 12 kinds of original Iranian arch, which has most application, are selected and after drawing for 3.5, 7, 10m span, isomorphic and circular arches are drawing with same span and same height, that come from original intersecting sections and shells of each one is modelled.

5   Behaviour of models

5.1   shells with original Iranian sections:

Iranian arches have variety forms, in this paper ,12 Iranian original arches are used that most applications, these arches are : Blunt panj- o- Haft (5- 0- 7), sharp panj- o-

Haf, Blunt shabdarie, sharp shabdarie, Blunt Holu- chin, sharp Holu- chin, Blunt shak-Bozee, sharp shakh-Bozee, Blunt se-Bakhshi, sharp se-Bakhshi, patupa, Bakhshi.[5]

Comparison of results shows that with increasing of arch height, enduring of structure decreases intangibly Fig1. Plasticity properties and bearing potential increase that are shown in figs. 2, 3, respectively. As we have recognized from figs 1 to 3, with increase in span length, potential bearing potential and porter criteria decrease and parameter of plasticity increases.

In continuation, amount of impressibility from fragmental load is explained. In this way different loading (0.75L, 0.5L, 0.25L) and all length of span is loaded and analysed and the results are shown in fig. 4, We can see 0.75Lfragmental loading shows lowest power of porter in these structures that amount of impressibility of fragmental load is shown in fig 8.It has seen that all these structures show lower impressibility from loading conditions and arch height.
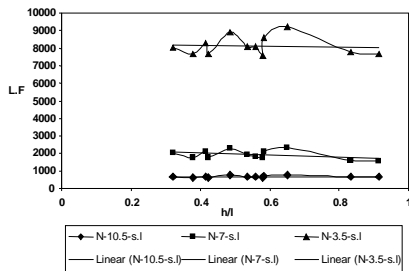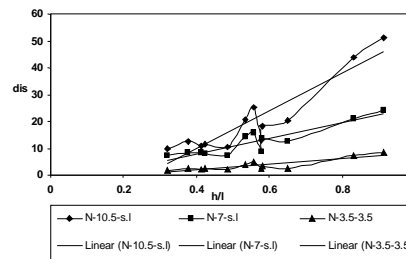

Fig 1. Porter criteria in traditional section

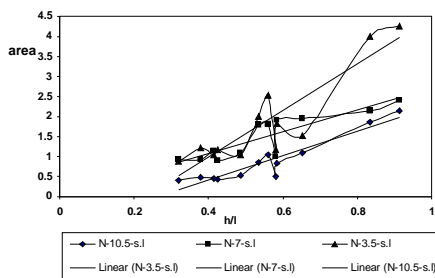Fig2. Plasticity criteria in traditional section

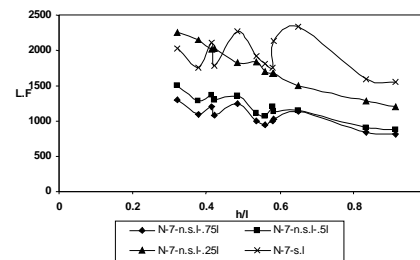Fig3. Enduring potential criteria in traditional section

Fig 4. Porter criteria of traditional section in fragmental loading

5.2 Shells with circular section:

Some of past architectural scientists said that these shells are best and strengthen arches. In order to compare after drawing original arches, circular arches equal of original arches (dimensions and loading conditions) are modeled and analyzed.

Comparison of results shows that by increasing arch height, power of structure bearing shows intangible decrease fig 5. And plasticity properties and bearing potential criteria increase and decrease, respectively, which are shown in figs 6-7.

As it can be shown in figs 5to7, by increasing span length, bearing potential criteria and porter criteria decrease and plasticity parameter increase. In continuation, amount of impressibility from fragmental load is explained. In this way loading 0.75L, 0.5L, 0.25L and all the length of loading span are analyzed that its result is shown in fig 8. It can be seen that in these structures 0.75L fragmental loading shows lowest power of porter that amount of impressibility of fragmental load is shown in fig 9. All these structures show highest impressibility from loading conditions and arch height than original arches.
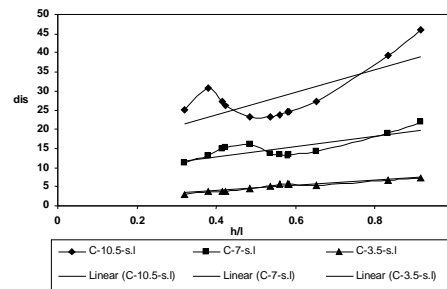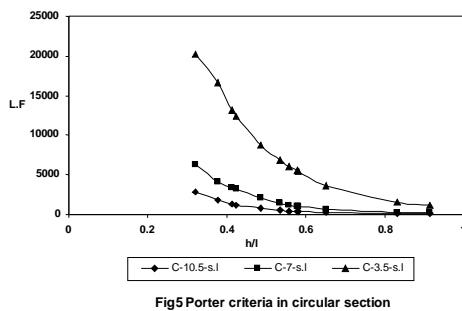

Fig5 Porter criteria in circular section

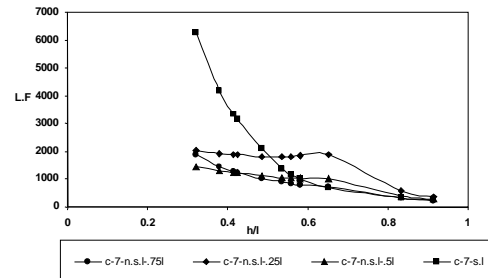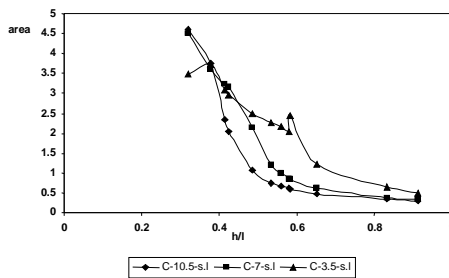Fig6 . Plasticity criteria in circular section

Fig7 . Enduring potential criteria in circular sections

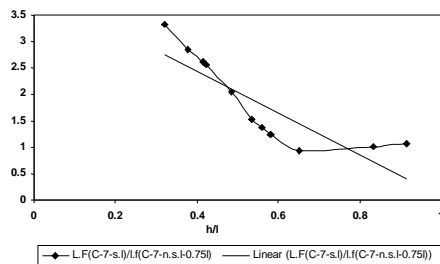Fig8 . Porter criteria of circular section in fragmental loading

Fig9 .Amount of impressibility of circular sections

6   study of section functions in comparison with Each other

For comparison, evaluating original and circular sections with each other, displacement- force diagram of each two sections is shown in fig (10).

As we can see, original sections have lowest and circular sections have highest effectiveness from height. Also, in sections with h/L<0/5 circular section and in section

with h/L>0/5 original sections show highest resistance criteria. It is for this resean that if h/L >0/5, so flexible mechanism is high and breakdown event is occurred. Also, each two kinds of sections in 0/75 L loading shows lowest resistance fig (11).
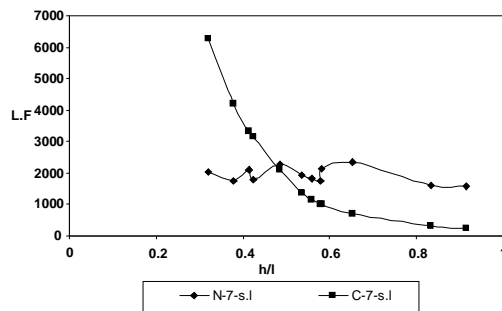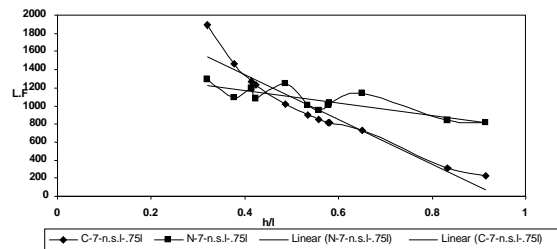

Fig 10. Porter criteria of different sections

Fig 11. Porter criteria for different section from critical fragmental loading

7   Results

By noting to this pape we can conclude that:

1) Amount of effectiveness of circular sections in more than arch height and these sections are part of sensitive sections toward height and loading conditions. So, one arch with high height as well as partly loading are synchronous, we must consider this matter carefully, and if the arch is placed under the soil and when these forces are connected to lower layers, they are spread to all of archs. This kind of arch is proposed.

2) Original sections are unsensitive to height and also conditions of party loading and amount of it's reduction in critical conditions of loading is appronimately 50%. So, if loading is in direct connection of arch, this kind of section is proposed.

3) Amount of effectiveness from loading condition in increased by redcing of arch height.

4) All of arch shells with high h/l have same behaviours

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