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CONSTURCTION SEQUENCE ANALYSIS OF TRASFER GIRDER

Chirag A Vaghamshi[1], Dr. Mahesh K Maroliya[2]

[1]*Faculty of Technology & Engineering, M. S. University of Baroda, Vadodara.*
[2] *Associate Professor Applied Mechanics Department,*
Faculty of Technology & Engineering, M. S. University of Baroda, Vadodara.

Abstract —*In case of structure like hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, or parking areas, large interrupted space is required for the movement of people or vehicles. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors. So to avoid this situation, transfer structure concept can be used. In tall building design, large opening at lower floor levels can be achieved by using transfer girders to collect the loads from closely spaced above columns and distribute them to small number of large and widely spaced supporting columns.*

Keywords-*Transfer structures, transfer girder, construction Sequence, creep, shrinkage, seismic load, Column Axial Shortening, P-D effect.*

I. Introduction

Now a days with the increase in population, land is becoming a premium. Therefore, instead of horizontal development, it is more feasible and preferable to have vertical development. Initially, it started with low-rise structures with about 5 stories but with time, the buildings are becoming taller and taller. Now we are even seeing around 20 storey buildings in major cities and even 100 storey buildings in metro cities in India.
The span to depth ratio of a transfer girder is generally very high as compared to that of a deep beam. The behavior of transfer girders is unique and the simple flexure theories will also not work as the flexure theory assumes that plane sections remain plane even after bending. But in case of transfer girders, their behavior depends on the span to depth ratio as well as the stiffening effect of the structure system above and below the transfer girder. The failure of transfer girder can be either as a tension member like a deep beam or in flexure like in normal beams.

II. Construction Stage Analysis

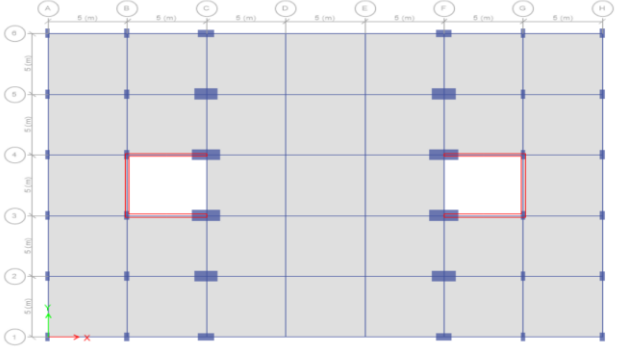
Behavior of building structures are generally determined using linear static loading on the building structure and summation of vertical loads in columns. However, when a building is under construction, its structural responses such as shear force, bending moments etc. may deviate from the actual behavior as the construction progresses because of continuous change in building stiffness and loadings coming on the building structure. In addition, time-dependent long-term deformations may change the structural responses of the building as the life of the building structure progresses.

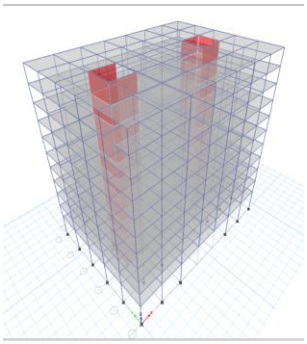
Factors affecting Construction Sequence Analysis

- ❖ Time dependent :Creep, Shrinkage
- ❖ Nonlinear Parameters : P-D effect, Column Axial Shortening

III. Problem Formulation

Building model as shown in figures and different size of transfer girders have been taken for getting the behavior of transfer girder. Building of 11 storey (G+10 structure) and have been considered for this study. Structure has three different depths of transfer girder. The height of the first storey has been kept as 5 meter in all the cases and the transfer girders are kept at the same level and their width are kept sufficient to support the columns coming onto them. The below image shows the plan of the building structure.





3.1. Transfer Girder

Transfer Girder	Size of Transfer Girder
Transfer Girder -1	700mmx1800mm
Transfer Girder-2	900mmx2000mm
Transfer Girder-3	900mmx2200mm

3.2. Construction load

Operational Class	Uniform Load	
	psf	kN/mm2
Very Light Duty: sparsely populated with personnel, hand tools, very small amounts of construction materials.	20	0.96
Light Duty: sparsely populated with personnel, hand-operated equipment, staging of materials for lightweight construction.	25	1.20
Medium Duty: concentrations of personnel, staging of materials for average construction.	50	2.40
Heavy Duty: material placement by motorized buggies, staging of materials for heavy construction.	75	3.59

3.3. Construction Sequence Timeline

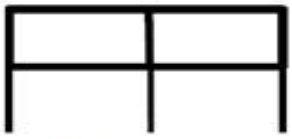
For providing the load in proper sequence in accordance with how the actual construction will happen on site for the building structure. So, the following things are considered to develop a hypothetical timeline of construction of the building structure in consultations with consultants working in field. The construction timeline has been kept as same buildings with both kinds of floor plans.

- At a time, there will be formwork and its loading will act on at maximum of 2 consecutive floors.
- 14 days after removal of formwork from a floor, wall load is applied and after that at 14 days floor finish is done on that floor.

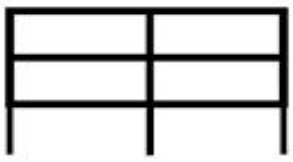
Step 1: Full Story

(a) Linear Static analysis is performed in only one step while not considering the sequential construction of each floor

Step 1: Story 1

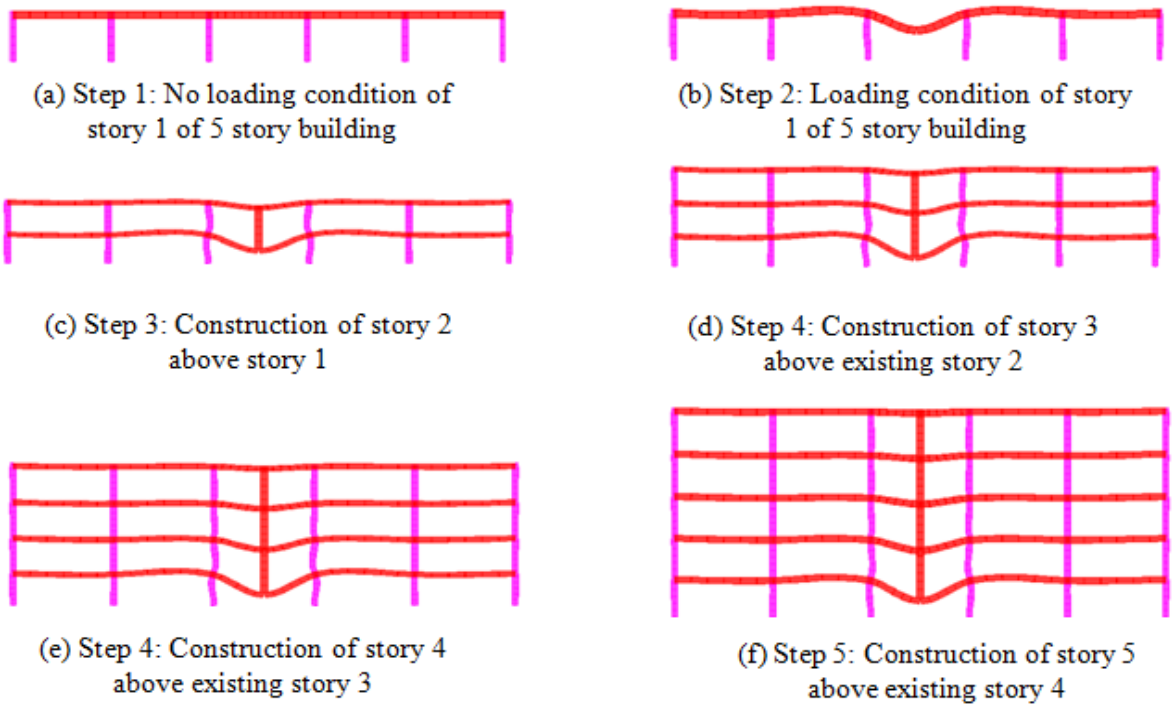


Step 2: Story 2



(b) Construction sequential analysis is performed after construction of each story like real scenario

3.4. Effect of Sequential Construction on Girder Subjected to Floating Column



(a) Step 1: No loading condition of story 1 of 5 story building

(b) Step 2: Loading condition of story 1 of 5 story building

(c) Step 3: Construction of story 2 above story 1

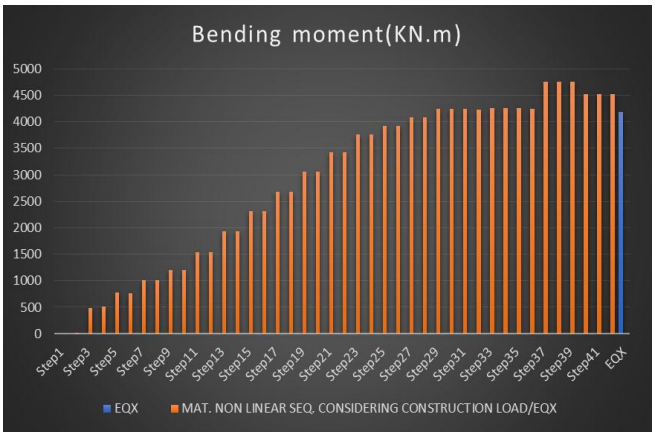
(d) Step 4: Construction of story 3 above existing story 2

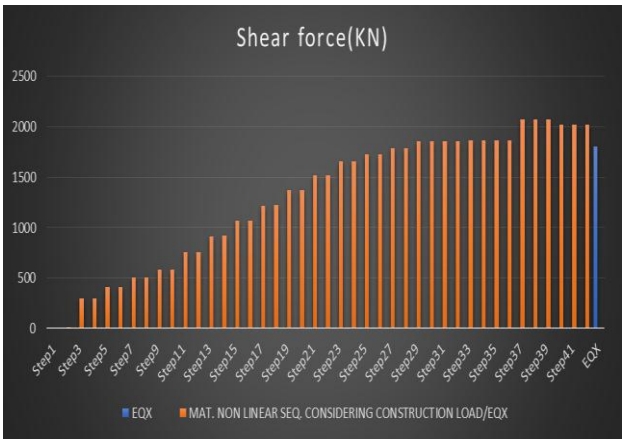
(e) Step 4: Construction of story 4 above existing story 3

(f) Step 5: Construction of story 5 above existing story 4

IV. Results and Conclusion

In all material nonlinear sequence considering construction with earth quack load second last stage is kept to understand the long term behavior of transfer girder at a period of 3 years and starting from 1st day when the construction done.
Maximum moments in case of construction sequence analysis considering time dependent parameters are more by about 20%-30% than in the case of construction sequence analysis without considering the time dependent parameters.
The maximum shear forces in transfer girder in Auto seq. sequence case is around 15-18% less than that in linear static case.
The study reveals the necessity to perform sequential analysis considering P-Delta effects, material characteristics and nonlinear behavior of the structures. Construction sequence analysis in structures is necessary to improve the prediction structural response in terms of displacement, axial, moment and shear force in supporting beam and column supporting transfer girder.





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