Study and Comparison of Construction Sequence Analysis With Regular Analysis By Using E-TABS

Ranga Shalini[1], G.Swarana[2]
[1, 2] Samskruti College of Engineering And Technology

Abstract- *Multi-storied buildings have been analyzed for years on the assumption that whole of the load is applied on the complete frame. Looking in to the mode of incidence of the load, it is evident that part of the load is applied in stages as the construction of the frame proceeds, whereas the remaining part of it is imposed on completion of the frame.*

The main factors affecting the limit state of serviceability of building are:-

1. *Creep and shrinkage*
2. *Span and cross section of the structural members*
3. *Cycle time for floor to floor construction and strength of concrete*

In present paper the main factor which we are considering is Cycle time for floor to floor construction and strength of concrete.

Due to architectural requirements some of the columns are designed as floating columns which rests on the transfer girder which intern rests on the shear walls in the multi-storied building. Two cases have been considered for the study and comparison. Whereas in Case 1 the building will be analyzed as a whole for the subjected loading (DL, LL, WL, SL) by using ETABS software and in Case 2 the building will be analyzed with reference to the construction sequence or staged construction for the subjected loading by using ETABS software.

I. OBJECTIVE AND SCOPE OF THIS INVESTIGATION

OBJECTIVE:

1) Analyzing the multi-storied building as a whole for the subjected loading(DL, LL, WL, SL) using ETABS software.

2) Analyzing the multistoried building with reference to the construction sequence or staged construction using ETABS software.

3) Comparison of the variation in deformations and forces for the transfer girders and the frames which is above the transfer girders.

SCOPE:

Deformations and forces for the transfer girders and the frame which is above the transfer girders for Twenty Two Storied building with reference to the conventional analysis and construction sequence analysis.

II. REVIEW OF LITERATURE

Chakrabarti, Nayak and Agarwalahad done the analysis on effect of sequence of construction in the analysis of multistoried building frame and concluded that the simulation of sequence of construction in the analysis leads to considerable variations in the design moments obtained by conventional one step analysis. It is therefore, necessary that for multistoried building frame the effect be taken into consideration.

Vafai, Ghabdian and Estekanchi had done the analysis on calculation of creep and shrinkage in tall concrete buildings using Non-linear staged construction analysis and recommended that a nonlinear stage construction analysis can be undertaken for regions with 60% relative humidity or less. In the design stage, it is better to avoid sudden changes in the cross section geometry or rebar percentages in adjacent members. If nonlinear staged construction analysis is to be used, critical values of relative humidity, rate of construction etc should be applied.

Kimand Shin had done the analysis on column shortening analysis with lumped construction sequences and concluded that saw-tooth shape of post-installation shortening can be modified by curve fitting and the modified shortenings show good agreement with the exact values.

Yip and Smith had done the analysis on serviceability performance of prestressed concrete buildings taking into

account long-term behavior and construction sequence and concluded that modeling of construction sequence is important for columns as the sequential jacking of floors increases the column moments especially at the lower part of the structure. The column moments are significantly affected by the boundary conditions at the foundation.

Rosenboom, Paret and Searerhad done the analysis on chronological construction Sequence, creep, shrinkage, and Pushover Analysis of an Iconic 1960s Reinforced Concrete Building and concluded that Expanding anon-linear static analysis to include time-dependent material properties, construction sequence, and the effect of creep and shrinkage reveals the importance of these effects on structural behavior, particularly when complex gravity load paths and restraint conditions create non-intuitive stress fields. For the subject building, a historic reinforced concrete shear wall building with unique lightweight aggregates, the chronological pushover confirmed field observations that cracking due to shrinkage and tensile creep from dead load and construction sequencing was more predominant in the building than any damage related to the 2006 earthquakes.

Adanur and Gunaydin had done the analysis on Construction stage analysis of Humber Suspension Bridge.Suspension bridges are widely used as engineering structures to across long spans and give rise to the usage of domainsunder the bridge. Construction period of this type of the structures continue along time and loads may be change during thisperiod. Therefore, construction stages and time dependent material properties should be considered in the analysis to obtainthe reliable and healthy results.

III. PLANNING AND DESIGNING THE MULTISTORIED STRUCTURAL FRAME WITH TRANSFER GIRDER AND FLOATING COLUMNS USING ETABS SOFTWARE

DESCRIPTION OF STRUCTURE:

The Project consists of residential multistoried building. The building is situated in Zone-III as per Indian standard code of practice IS: 1893-2002.

The structure is a reinforced concrete frame with conventional beam slab system. Lateral stability for the structure is provided by shear walls and are provided suitably at selected places. Floating columns are starting from ground floor.

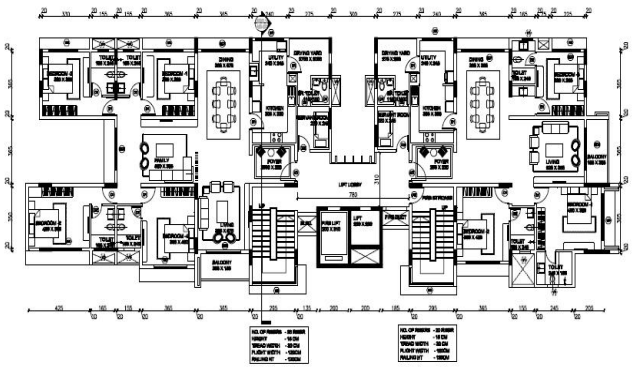
It's a LB+UP+ G+22 upper floors building. Lower Basement and upper basement is used for car park and the other floor serves residential purpose.

5.1.1 FOUNDATION:

The foundations are mainly pile foundations with raft on plies. As per geotechnical investigation report soil type – 1 is considered for seismic analysis.

5.2 DESIGN STANDARDS:

- Structural Designs are carried out as per Indian Standards. Following are the list of codes used.
- IS 456: 2000 Code of practice for plain and reinforced concrete?
- IS 875: 1987 (Part 1 to 5) Code of practice for design loads (other than earth quake).
- IS 1893:2002 Criteria for earthquake resistant design of structures (fourth revision).
- IS 4326:1993 Code of practice for
- earthquake resistant design and construction of buildings (second revision).
- IS 13920:1993 Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.



① TYPICAL FLOOR PLANS

IV. RESULTS AND DISCUSSIONS

With reference to the above mentioned conventional lumped and construction stage analysis results are presented and compared in the Table – 7.1.

Table: 7.1 percentage increase in sequence analysisV.

CONTENT	LUMPED ANALYSIS	SEQUENTIAL ANALYSIS	PERCENTAGE INCREASE IN SEQUENTIAL ANALYSIS
Deformation of TB1 (mm)	8.105	11.363	28.67%
Deformation of frame above TB1 (mm)	9.695	13.062	25.78%
Column force of the column above TB1 in ground floor (kN)	3300.78	4839.44	31.79%
Bending moment of TB1 (kN-m)	4798.46	7041	31.85%
Shear force of TB1 (kN)	1915.73	2817	31.99%
Bending moment of frame above TB1 (kN-m)	76.14	108.69	29.95%
Shear force of frame above TB1 (kN)	59.1	76.78	23.03%
Deformation of TB2 (mm)	8.277	11.374	27.23%
Deformation of frame above TB2 (mm)	9.822	13.027	24.60%
Column force of the column above TB2 in ground floor (kN)	3330.6	4861.36	31.49%
Bending moment of TB2 (kN-m)	4840.92	7084	31.66%
Shear force of TB2 (kN)	1930	2833	31.87%
Bending moment of frame above TB2 (kN-m)	75.35	103.81	27.42%
Shear force of frame above TB2 (kN)	58.77	74.67	21.29%

With reference to the above results comparison presented in Table – 7.1, there is an average of 30% increment of deformations and design forces in sequential analysis compared to conventional analysis which is highly considerable.

V. CONCLUSION

It is evidenced that simulation of sequence of construction in the analysis leads to considerable variations in deformations and design forces obtained by conventional analysis.

It is, therefore necessary that for Multi storied building frames with transfer girders and floating columns system, the construction sequence effect shall be taken into consideration.

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