15 -ാം കേരള നിയമസഭ

3 -ാം സമ്മേളനം

നക്ഷത്ര ചിഹ്നം ഇല്ലാത്ത ചോദ്യം നം. 3637 **26-10-2021 - ൽ മറുപടിയ്ക്ക്**

കോഴിക്കോട് കെ.എസ്.ആർ.ടി.സി. ബസ് ടെർമിനലിന്റെ ബലക്ഷയം

ചോദ്യം		ഉത്തരം	
ശ്രീ. തിരുവഞ്ചൂർ രാധാകൃഷ്ണൻ		**Shri Antony Raju** **(ഗതാഗത വകുപ്പ് മന്ത്രി)**	
(എ)	കോഴിക്കോട് കെ.എസ്.ആർ.ടി.സി. ബസ് ടെർമിനലിന് ബലക്ഷയമുണ്ടെന്ന് ചെന്നൈ ഐ.ഐ.ടി. യുടെ പഠനത്തിൽ കണ്ടെത്തിയിട്ടുണ്ടോ; പ്രസ്തുത പഠന റിപ്പോർട്ടിന്റെ പകർപ്പ് ലഭ്യമാക്കുമോ?	(എ)	കോഴിക്കോട് കെ.എസ്.ആർ. ടി.സി. ബസ് ടെർമിനലിന് ബലക്ഷയമുണ്ടെന്നു ചെന്നൈ ഐ ഐ ടിയിലെ വിദഗ്ധൻ കണ്ടെത്തിയിട്ടുണ്ട്. വിശദമായ പഠനത്തിനുശേഷം സമർപ്പിച്ച റിപ്പോർട്ടിൽ പറയുന്നത് ഇപ്രകാരമാണ്. "നിലവിൽ ബസ് ടെർമിനലിന്റെ അവസ്ഥ നിർണ്ണായകമാണ്. ബേസ്മെന്റ് B1 ഫ്ലോറിലെ സ്റ്റാബുകളിൽ Multiple Cracks ഉള്ളതിനാലും, ബീമുകളിലെ ക്രാക്കുകൾ ന്യൂട്രൽ ആക്സിസും മറികടന്നു പോയതിനാലും ബസ് ടെർമിനലിന്റെ ബസ് ബേ ഫ്ലോർ, ചെന്നൈ ഐ.ഐ.ടി മുഖാന്തിരം repair and rehabilitation ജോലികൾ പൂർത്തീകരിക്കുന്നതുവരെ ബസ് ഓപ്പറേഷൻ പാടുള്ളതല്ല". മേൽ പറഞ്ഞ ഐ.ഐ.ടി ചെന്നൈയുടെ റിപ്പോർട്ട് 2046 പേജുകൾ അടങ്ങിയതാണ്. അതിന്റെ ശുപാർശകൾ ഉൾക്കൊള്ളുന്ന പ്രസക്ത ഭാഗം ബഹുമാനപ്പെട്ട മെമ്പറുടെ ആവശ്യപ്രകാരം ഇതോടൊപ്പം വയ്ക്കുന്നു.

സെക്ഷൻ ഓഫീസർ

CONDITION ASSESSMENT AND REPAIR AND REHABILITATION OF KSRTC BUS TERMINAL COMPLEX AT KOZHIKODE

1.0 INTRODUCTION

The Principal Project Consultant, Kerala Transport Development Finance Corporation (KTDFC) asked IIT Madras to check the stability of the existing Bus Terminal Complex at Kozhikode Corporation, Kerala and suggest suitable repair and rehabilitation procedures to arrest the cracks on the beams and slabs in the basements B2 and B1 (RB/19-20/CE/552/KTDF/005034). IIT Madras conducted UPV tests, RHN tests and extracted and tested concrete cores on the selected beams and slabs and submitted Report 1 (Non-Destructive and Partially Destructive Testing) on 01-06-2020.

The commercial complex consists of two Towers A and B with common basement floors (B1 and B2) and ground floor (GF) and 10 upper floors in Tower A and Tower B. KTDFC submitted the hard copies of the available structural drawings and soft copies of the architectural drawings to IIT Madras. The architectural drawing of the basement floor is shown in Fig. 1, mezzanine floor plan in Fig. 2 and typical floor plan (from 3rd floor level) in Fig. 3. It is noted that the finite element (FE) model of the building and analysis and design basis report (DBR) of the complex are not available with KTDFC. Using the available architectural and structural drawings, IIT Madras generated a 3D model of the complex in ETABS Ultimate 1 19.0.2, a FE analysis and design software to analyse and check the stability of the complex and arrive the repair and rehabilitation procedures. The repair and rehabilitation procedures will be arrived based on the capacity of the foundation.

Static and dynamic analyses are carried out using the generated 3D model of the complex for three different load cases such as (i) DL and LL combination, (ii) DL, LL, WL and SL combinations for the limit state of serviceability conditions and (iii) DL, LL, WL and SL combinations for the limit state of collapse in accordance to IS 456: 2000 and IS 1893(Part1): 2016, to check the stability of the complex and arrive repair and rehabilitation procedures to arrest the structural cracks developed on the beams and slabs in the basements B2 and B1.

The details of the static and dynamic analyses, existing capacity of the columns, beams and slabs obtained for the specified loading under the three different load cases such as (i) DL and LL combination, (ii) DL, LL, WL and SL combinations for the limit state of serviceability conditions and (iii) DL, LL, WL and SL combinations for the limit state of collapse are given in this report.

6.0 ETABS PROJECT REPORT

ETABS project report for the blocks (i) B1 and B5, (ii) B2 and B4 and (iii) B3 are given in Appendix 1, Appendix 2 and Appendix 3 respectively.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 The bus terminal complex (framed structure) consists of 923 columns, 3545 beams and 1611 slabs. The capacity of the columns, beams and slabs are checked for the maximum forces obtained for the critical load combinations under three different load cases such as (i) DL and LL, (ii) DL, LL, WL and SL (limit state of serviceability) and (iii) DL, LL, WL and SL (limit state of collapse) and the summary is given in Tables 1, 2 and 3 respectively.

7.1.1 In accordance to Table 1, for the specified loading under load case DL and LL, 209 columns (23%), 243 beams (7%) and 322 slabs (20%) are failing due to insufficient size and area of steel reinforcements.

7.1.2 In accordance to Table 2, for the specified loading under load case DL, LL, WL and SL (limit state of serviceability), 735 columns (80%), 2521 beams (72%) and 322 slabs (20%) are failing due to insufficient size and area of steel reinforcements.

7.1.3 In accordance to Table 3, for the specified loading under load case DL, LL, WL and SL (limit state of collapse), 875 columns (95%), 2802 beams (80%) and 870 slabs (55%) are failing due to insufficient size and area of steel reinforcements.

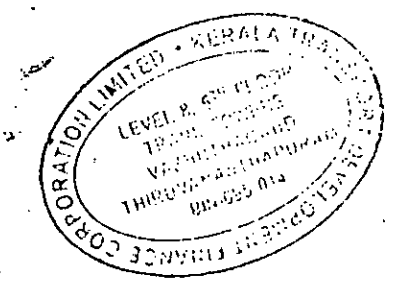
7.2 Even without any live load on the basement B2 roof slabs, structural cracks have formed on certain beams and roof slabs of basement B2. This shows that the quantity of steel reinforcement provided in the beams and slabs may be less than the quantity of steel shown in the relevant drawings.

7.3 Abrupt change in the diameter (size) of steel reinforcement bars and number of bars in the columns and diameter of steel reinforcement bars in the beams are noted in the drawings of the Bus Terminal Complex.

7.4 The condition of the building is observed to be critical. Since the structural cracks on the roof beams of basement B1 (Bus Bay Floor) have extended beyond the neutral axis and multiple structural cracks have formed on the roof slabs, the Bus Bay Floor cannot be utilized for vehicle operations until the repair and rehabilitation works are completed.

7.5 The capacity of Tower A and B including the basements is found to be insufficient for any additional dead load and live load due to the existing critical condition.

IIT Madras will suggest suitable repair and rehabilitation procedures along with materials and specifications and BOQ in accordance to the capacity of the foundation.



CONDITION ASSESSMENT AND REPAIR AND REHABILITATION OF KSRTC BUS TERMINAL COMPLEX AT KOZHIKODE

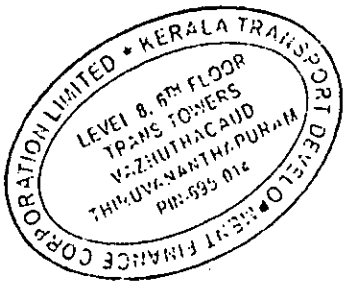
INTERIM REPORT ON ANALYSIS AND DESIGN

1.0 INTRODUCTION

The Principal Project Consultant, Kerala Transport Development Finance Corporation (KTDFC) asked IIT Madras to check the stability of the existing Bus Terminal Complex at Kozhikode Corporation, Kerala and suggest suitable repair and rehabilitation procedures to arrest the cracks on the beams and slabs in the basements B2 and B1(RB/19-20/CE/552/KTDF/005034). IIT Madras conducted UPV tests, RHN tests and extracted and tested concrete cores on the selected beams and slabs and submitted Report 1 (Non-Destructive and Partially Destructive Testing) on 01-06-2020.

The commercial complex consists of two Towers A and B with common basement floors (B1 and B2) and Ground floor and 10 upper floors in Tower A and Tower B. KTDFC submitted the hard copies of the available structural drawings and soft copies of the architectural drawings to IIT Madras. The architectural drawing of the basement floor is shown in Fig. 1 and typical floor plan in Fig. 2. It is noted that the finite element (FE) model of the building, analysis and design basis report (DBR) of the complex are not available with KTDFC. Using the available architectural and structural drawings, IIT Madras generated a 3D model of the complex in ETABS (Figs. 3, 4, 5 and 6), a FE analysis and design software to analyse and check the stability of the complex and arrive the repair and rehabilitation procedures.

Static and dynamic analyses are carried out using the generated 3D model for the critical load combinations in accordance to IS 456: 2000 and IS 1893(Part1): 2016 including DL and LL and DL, LL, WL and SL serviceability conditions to check the stability of the complex and to arrive repair and rehabilitation procedures to arrest the cracks on the beams and slabs in the basements B2 and B1. Dead loads (DL) and live loads (LL) are considered in accordance to IS 875: 1987. The wind load (WL) is calculated in accordance to the basic wind speed (based on 50-years return period) given in Fig.1, Pg. No: 6, IS 875 (Part 3): 2015. Seismic loads (SL) are calculated in accordance to the seismic zone of India given in Fig.1, Pg. No: 11, IS 1893(Part1): 2016. The summary of the analysis and design are given in this report.



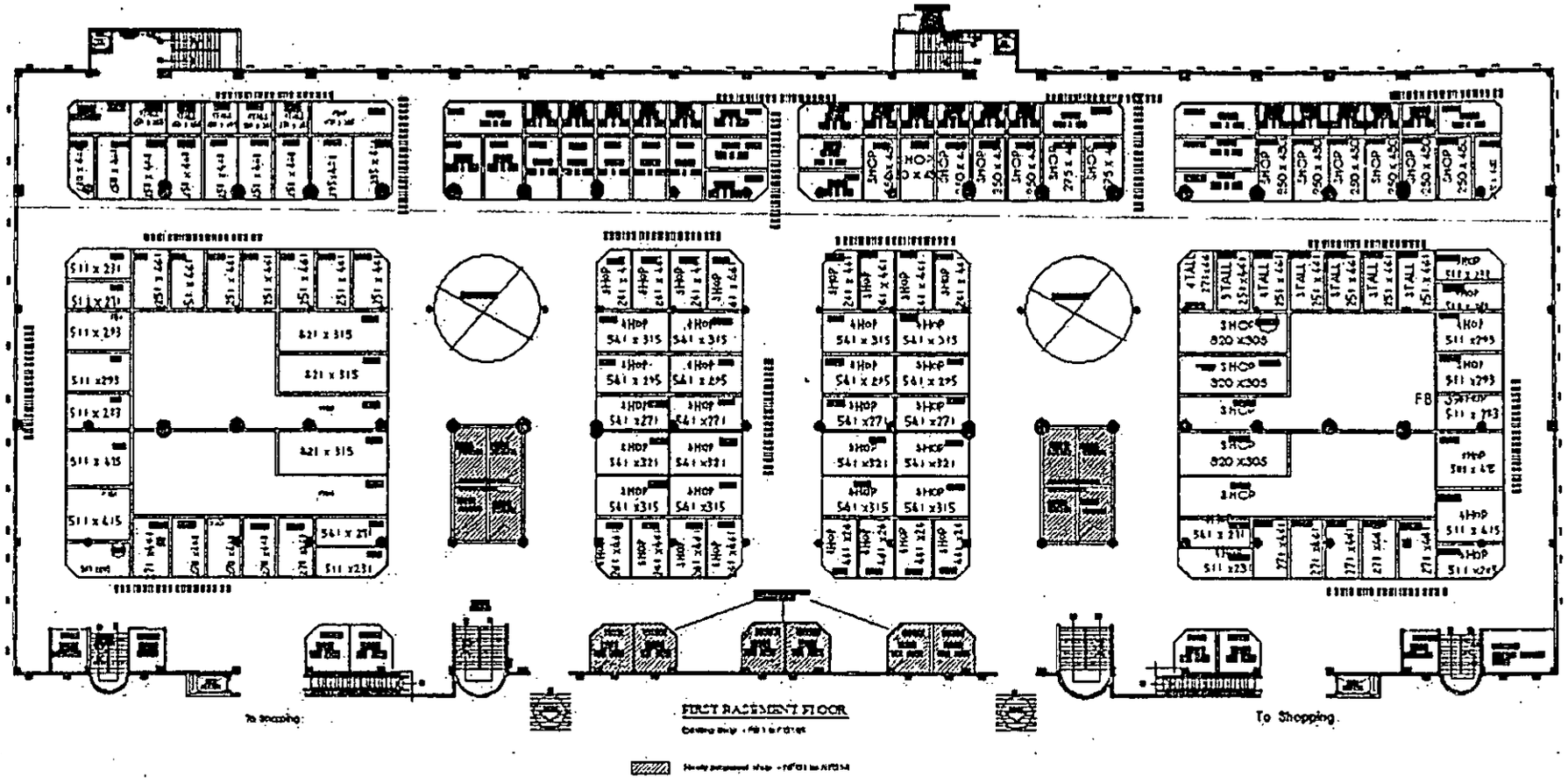


Fig.1 Basement Floor of Tower A and Tower B

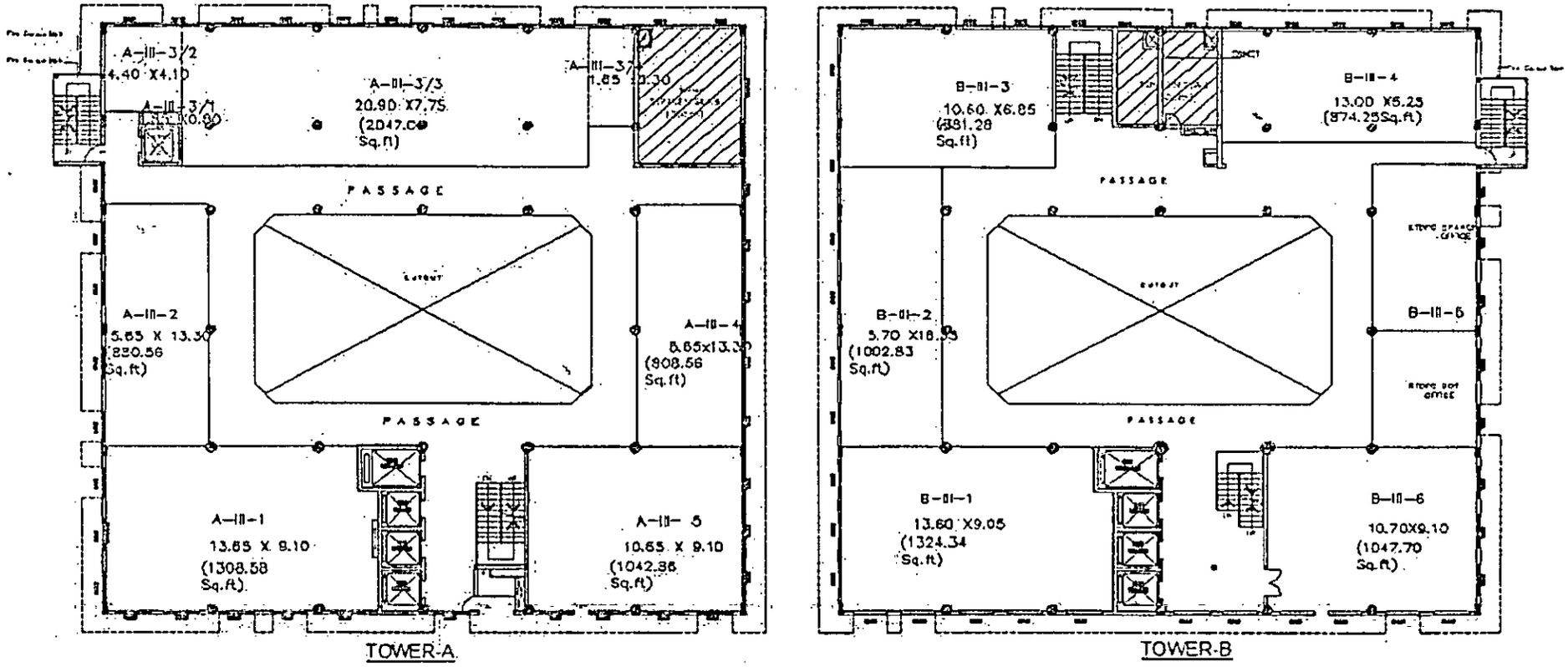


Fig.2 Typical Floor Plan of Tower A and Tower B

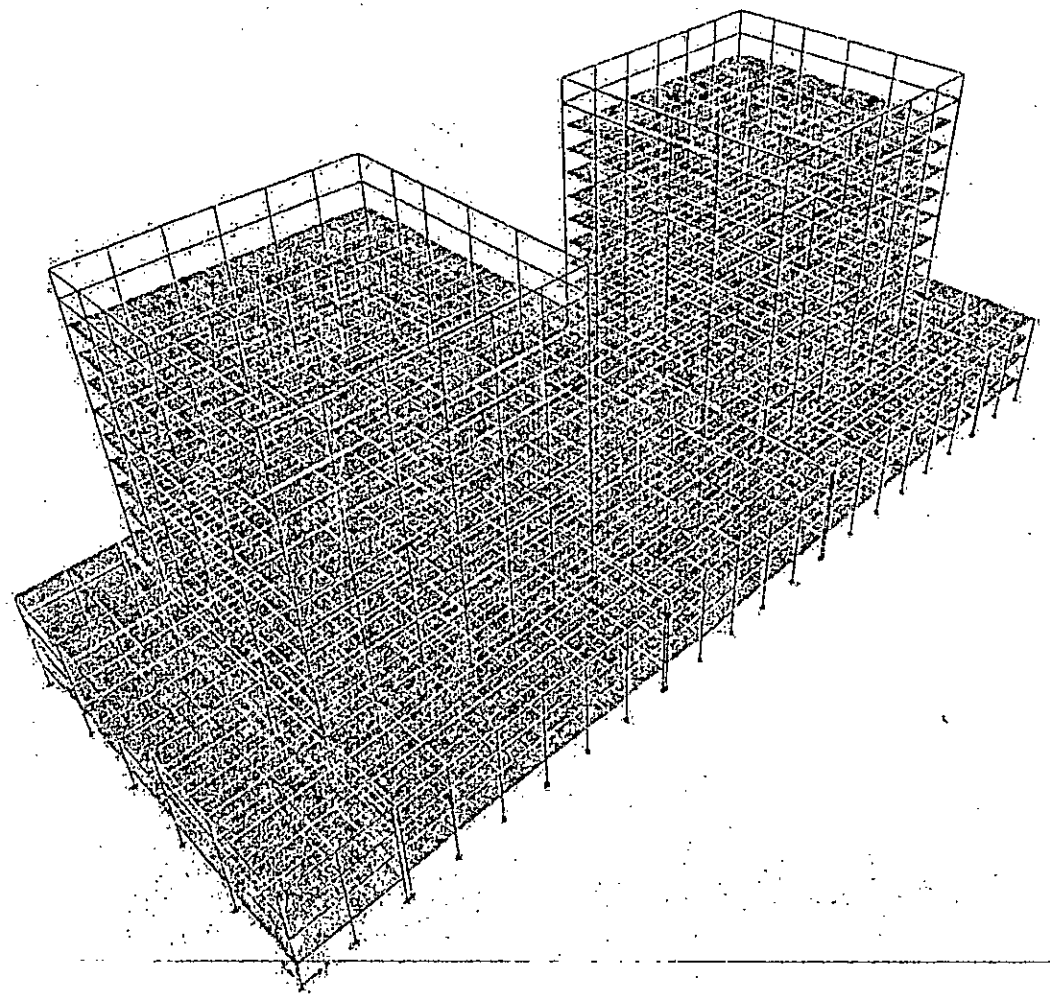


Fig. 3 3D Wire Frame Model of the Tower A and Tower B

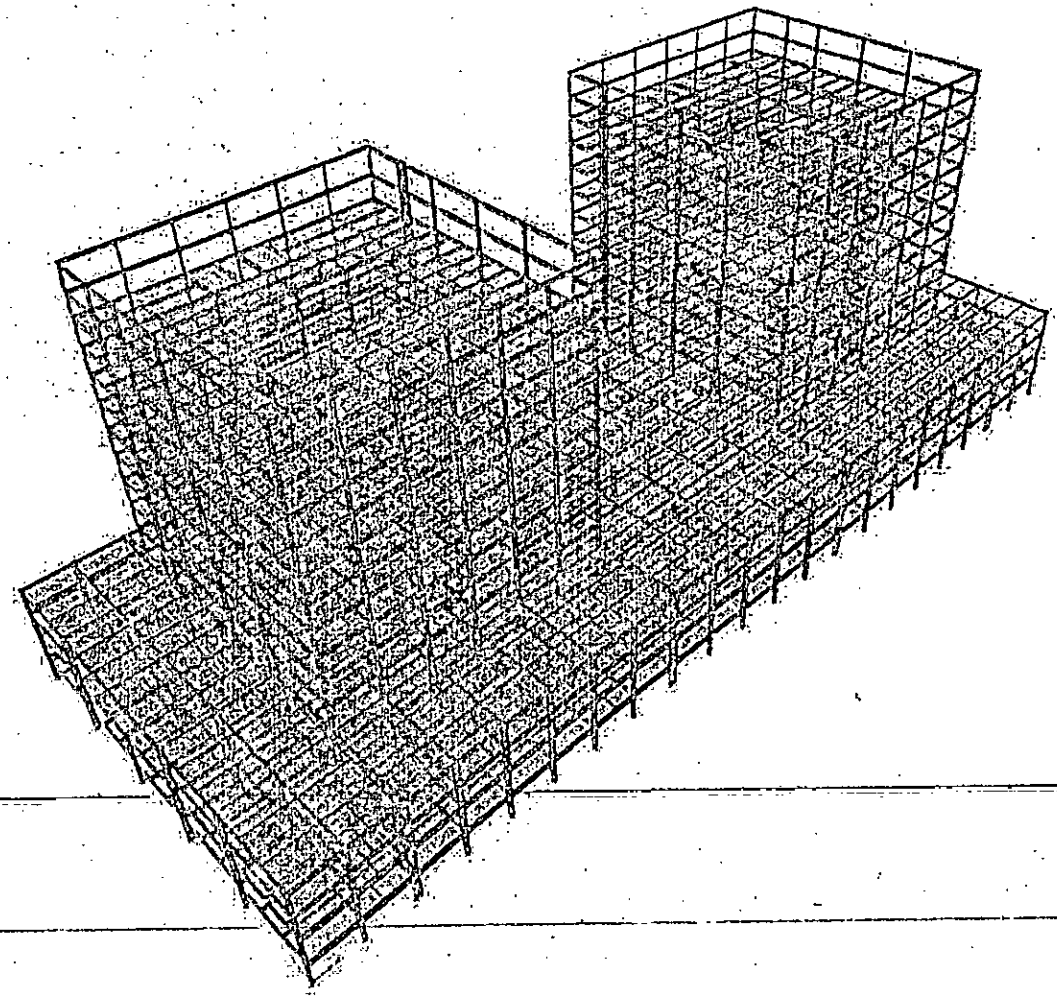


Fig.4 3D Model of the Tower A and Tower B

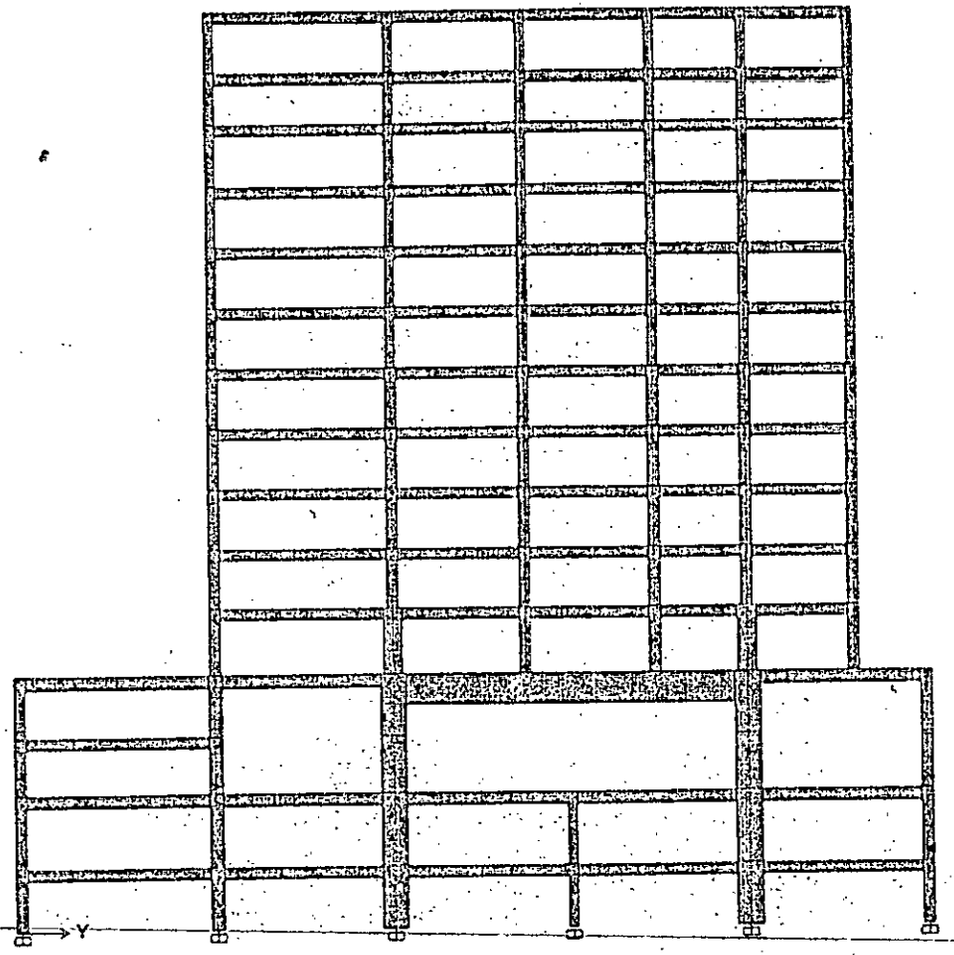


Fig. 5 Side View of Tower A and Tower B

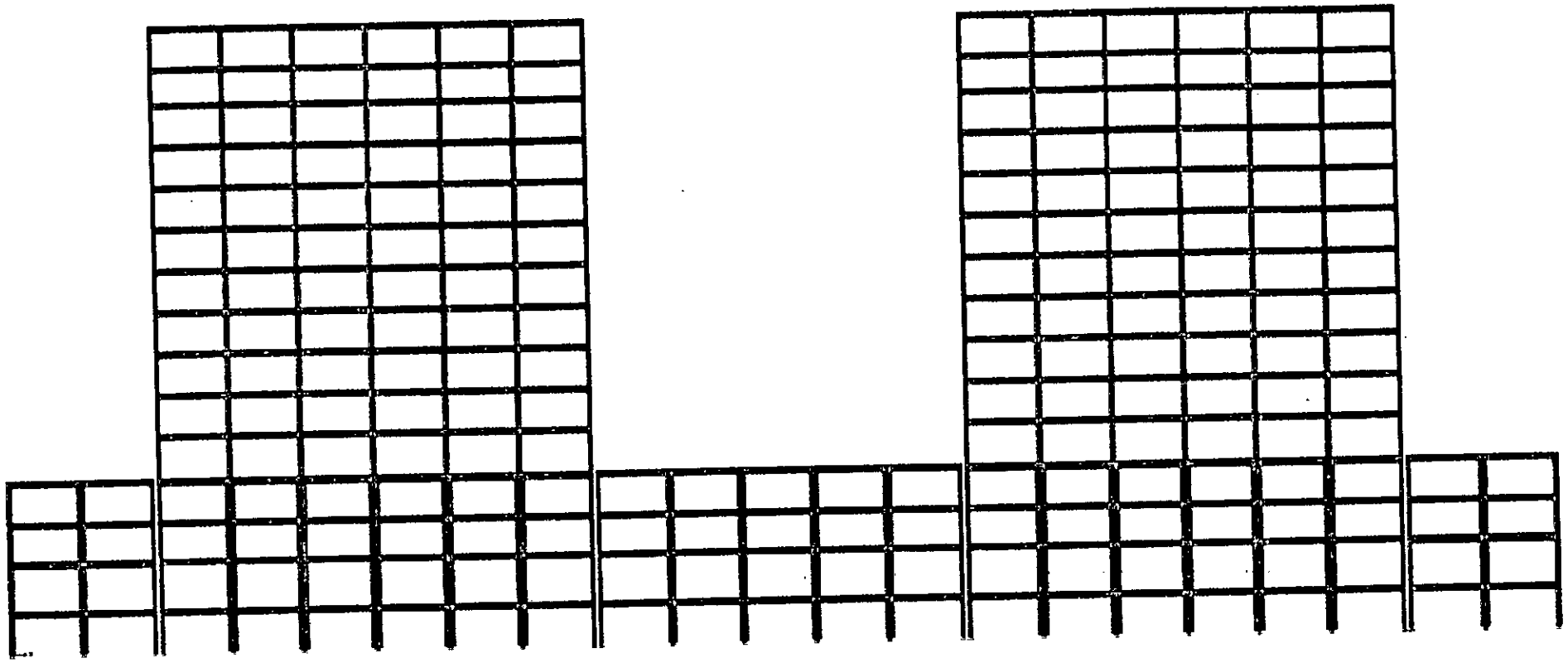


Fig.6 Elevation of Tower A and Tower B

SUMMARY

The load combinations considered in the analysis and design and the total no. of columns, beams and roof slabs failing under each load combination are given in Tables 1, 2 and 3.

Case 1: Load Combination DL and LL

Table 1 Condition of Structural Elements under DL and LL Combination

Sl. No.	Block	Level	Total No. of Structural Elements			Structural Elements with Insufficient Capacity					
						Columns		Beams		Slabs	
			Columns	Beams	Slabs	Nos.	%	Nos.	%	Nos.	%
1	B1	L1 to L4	923	3545	1611	**209**	**23**	**243**	**7**	**322**	**20**
	B2	L1 to L13									
	B3	L1 to L4									
	B4	L1 to L13									
	B5	L1 to L4									

Case 2: Load Combination DL, LL, WL and SL under Serviceability Condition

Table 2 Condition of Structural Elements under DL, LL, WL and SL Combinations

Sl. No.	Block	Level	Total No. of Structural Elements			Structural Elements with Insufficient Capacity					
						Columns		Beams		Slabs	
			Columns	Beams	Slabs	Nos.	%	Nos.	%	Nos.	%
1	B1	L1 to L4	923	3545	1611	**735**	**80**	**2521**	**72**	**322**	**20**
	B2	L1 to L13									
	B3	L1 to L4									
	B4	L1 to L13									
	B5	L1 to L4									

Case 3: Load Combination DL, LL, WL and SL under Collapse Criterion

Table 3 Condition of Structural Elements under Collapse Criteria

Sl. No.	Block	Level	Total No. of Structural Elements			Structural Elements with Insufficient Capacity					
						Columns		Beams		Slabs	
			Columns	Beams	Slabs	Nos.	%	Nos.	%	Nos.	%
1	B1	L1 to L4	923	3545	1611	875	95	2802	80	870	55
	B2	L1 to L13									
	B3	L1 to L4									
	B4	L1 to L13									
	B5	L1 to L4									

Suggestions and Recommendations

As per the summary of the analysis and design as shown in Tables 1, 2 and 3, most of the columns, beams and roof slabs in the basement floors and upper floors of Tower A and Tower B are failing due to insufficient quantity of steel reinforcement in accordance to IS 456:2000. M30 grade of concrete is considered in the analysis.

It is also noted that even without any live load on basement B2 roof slabs, structural cracks have formed on certain beams and roof slabs of basement B2. This shows that the quantity of steel reinforcement provided in the beams and slabs may be less than the quantity of steel shown in the relevant drawings.

Abrupt change in the diameter of steel reinforcement bars and number of bars in the columns and diameter of steel reinforcement bars in the beams are also noted in the drawings of the Bus Terminal Complex.

The condition of the building is observed to be critical. Since the structural cracks on the roof beams of basement B1 (bus bay floor) have extended beyond the neutral axis and multiple structural cracks have formed on the roof slabs, the Bus Bay Floor cannot be utilized for vehicle operations until the repair and rehabilitation works are completed.

It is noted that the capacity of Tower A and B including the basements is found to be insufficient for any additional dead load and live load due to the existing critical condition.

IIT Madras will suggest suitable repair and rehabilitation procedures along with materials and specifications and BOQ as per the capacity of the foundation.

P. Alagusundaramoorthy

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KERALA TRANSPORT DEVELOPMENT FINANCE CORPORATION LIMITED * LEVEL 8, 6TH FLOOR TRANS TOWERS VAZHUTHACAUD THIRUVANANTHAPURAM PIN-695 014