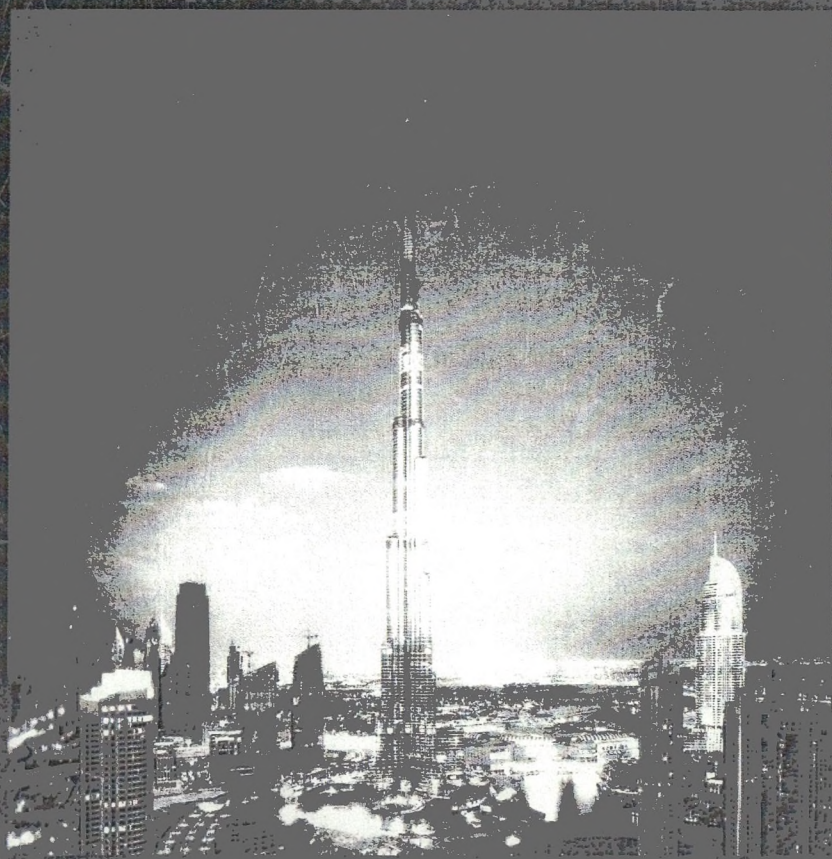




WORLD ACADEMY OF SCIENCE, ENGINEERING AND TECHNOLOGY  
ENGINEERING AND TECHNOLOGY  
YEAR 7, ISSUE 1



# A 'Socially Responsive' House Plan as a 'Disaster Preparedness' Module

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**Abstract**— Shelter is the basic requirement of human beings. In these days of unprecedented disasters the need for disaster resistance and management assumes prime importance. The tsunami that struck the coasts of Tamil Nadu in INDIA has taught a great lesson. Massive destruction in terms of lost lives, washing away of houses and belongings was witnessed. Globally as a management prerogative construction of disaster resistant dwellings being recommended, an earnest effort to develop a disaster resistant and socially responsive (user- friendly) model of a house was drafted. The paper elaborates on the same.

**Keywords**— Disaster resistance, Dwellings, Management, socially responsive, Model house

## I. INTRODUCTION

Shelter is the basic human requirement. A dwelling, the residence, is the outer shell, which provides space for the activities of living as well as safety and protection. Inadequate and improper housing affects both health and productivity of the inmates. Success in planning a house is measured by the amount of gratification the family gets out of every square unit of the layout. But, almost, 80 per cent of the buildings are non-engineered, that is, built without the supervision or guidance of a qualified engineer and therefore these structures will be the worst affected in case a disaster strikes.

The need for disaster preparedness and management are being increasingly recognized as important aspects not only in the recovery process, but also as an integral to the development process. In the event of a disaster, it is extremely important to identify at an early stage, an approach which would have long-term implications.

It is essential to take a comprehensive view and analyze various aspects right from the beginning so as to mitigate disasters in the future, their complications and alleviate problems of the affected people and also evolve socially responsive structures.

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The last decade (1990-2000) was declared by UN as the International Decade of Natural Disaster Reduction (IDNDR). The focus during the decade was to shift from traditional relief distribution to the community after disasters towards preparedness and mitigation. Tsunami is a recent disaster that had impacted many. The key factors to reduce potential losses due to tsunami are awareness and preparedness.

To tackle such exigencies, a multipronged approach should be thought about in terms of disaster reduction, disaster prevention and disaster management. To tackle such exigencies, a multipronged approach should be thought about in terms of disaster reduction, disaster prevention and disaster management. The Tamil Nadu Government's reports signify the fact that almost the whole of the coastline and its shore has been affected by Tsunami. The total area of Tamil Nadu in India is 1, 30,058 Sq.Km which forms about four per cent of the total land area of the country and has a long coastline, nearly 1000 Km in length representing 12 per cent of the entire coastline in the country. Tamil Nadu state has been identified by the Vulnerability Atlas of India as prone to multi-hazards, which include severe cyclones, moderate earthquakes, tidal waves in coastal regions, severe corrosion, environment and other man-made disasters like fire and blasts. Almost all disasters are accompanied by loss of property, infrastructure and life. Most of the losses of life in past earthquakes, cyclones and tsunami have occurred due to the collapse of buildings, constructed in traditional materials which were not particularly engineered to be earthquake and cyclone resistant [1]. The urgent and immediate concerns of the people then relate to security, housing and livelihood.

Knowing that India is vulnerable to repeated onslaught of various types of disasters (especially Tamil Nadu is graded to fall under Zone II as per the Seismic Zone map of India - IS: 1973-1984) well above Zone II range [2], the overarching issue lies in preparing oneself for the worst and be alert to safeguard oneself in times of insurgency. Among the disasters, of late, earthquakes seem to occupy the topmost rank. Since an earthquake is a short-lived phenomenon and since most damage to life and property is caused by collapses of poorly constructed buildings and habitats, the accompanying toll of life can be mitigated by suitable disaster management programs. The impact of earthquakes is sudden with little or no warning making it just impossible to predict it and take timely precautions against collapse of man-made structures. To

prevent higher damages pre-disaster activities have a significant role to play.

The aphorism that Earthquakes do not kill people, but buildings 'do' has been proved true (1,26,182 houses damaged during Tsunami), for, poor resistance to earthquake, causes building collapse and severe damage, which leads to loss of lives [3]. On the morning of December 26th, 2004 a magnitude 9.3 earthquake near Sumatra in Indonesia shook the ground with the energy of tens of thousands of Hiroshima – size atomic bombs. The following Table presents the extent of calamity witnessed in India as reported on 3rd Feb 2005 at 10.05:37 hours IST [3]-[4].

TABLE I  
DAMAGES CAUSED BY TSUNAMI IN TAMIL NADU

Districts Affected	Population Affected	Houses/Huts Damaged	No. of Human Lives Lost	No. Injured
Chennai*	73000	17805	206	55
Cuddalore*	99704	15200	617	198
Kancheepuram	100000	7043	129	14
Kanyakumari*	187650	31175	828	727
Nagapattinam*	196184	39941	6065	1922
Pudukkottai	66350	1	15	-
Ramanathapuram	0	6	6	0
Thanjavur	29278	3	33	482
Thiruvallur	15600	4143	29	0
Thirvarur	0	0	28	0
Thirunelveli	27948	630	4	4
Tuticorin	110610	735	3	0
Villupuram	78240	9500	47	30
<b>Total</b>	<b>984564</b>	<b>126182</b>	<b>8010</b>	<b>3432</b>

Tsunami has not struck the Tamil Nadu coasts alone. It had also caused havoc in the adjacent shorelines.

TABLE II  
THE DEVASTATION

Details	Tamil Nadu	Kerala	Andra pradesh	Pondic herry	Andaman & Nicobar	Total
Population affected (in lakhs)	8.97	13	1.96	0.43	3.56	27.92
Number of Villages affected	376	187	301	33	192	1089
Deaths*	8009	177	107	599	3513	12405
Orphaned children	289	3	6	39	143	480
Houses damaged	190000	13735	481	10061	21100	235377
Cropped area affected (hectare)	19168	7763	302	792	11010	39035
Boats damaged	52638	10882	12189	6678	1401	83788

Livestock lost	1653	0	86	2685	27331	31755
Damage (Rs.in crores)	4528.66	2371.02	342.67	466	3836.56	11544.9

In monetary terms the damage was estimated at about Rs.11, 544.91 crore, where Tamil Nadu bore the brunt – Rs.4528.66 crore (39%).

Experiences learnt from tsunami are more than enough. Presence of poorly engineered Kutcha houses, very near to the shoreline had acted as a corollary to their destruction or washing away due to Tsunami. This status quo has to be averted in future. People from all walks of life need to be roped in. It would be naive to assume that disasters will stop. We cannot change the nature of disasters. What we can change, certainly control, is the scale that a disaster wreaks. This is precisely what disaster preparedness as a mouthful in the abstract, to face a cataclysm as sudden and neutral, is about. So disaster preparedness has to be planned.

A 'pot pourri' of all types of disaster mitigation measures have to be deployed. Disaster management efforts can be categorized under pre-disaster phase, during and short time after disaster phase or emergency phase and post disaster phase. Streamlining of action should be as given below.

Pre-disaster phase	Emergency phase	Post – disaster phase
Awareness campaigns	• Communication network	Community Participation
Earthquake resistant Construction	• Restriction on sympathizers	Economic rehabilitation
Training	• Rescue operation.	Social
Development of Emergency action plan	• Distribution of relief materials.	rehabilitation
	Medical aid	
	Coordination.	
	• Transparency	
	media watch.	
	• Emergency/temp orary shelters for survivors.	

The role of academic institutions and research scholars here cannot be relegated. With this backdrop, a research study on measures to mitigate future calamities, thereby conserving resources was envisaged. Being from the department of Resource Management, focus on conservation of all types of resources receives serious address. For all, their 'dwelling' is a prestigious and precious resource. Safeguarding it from disasters of all kinds becomes the primary responsibility of every human being. Bestowing due concern from its construction would reap dividends in the long run. Awed by the overwhelming participation of public and NGOs, and

being scholars in the Department of Resource Management, a natural desire to contribute our mite to the noble natural cause was kindled to launch a study on "A 'Socially Responsive' Dwelling Design for Disaster Prone Areas", as a part of a recent study.

The havoc caused by tsunami had left a permanent dent in the lifestyles of the survivors, which no amount of tinkering could set right. But, 'preparedness' among all could help prevent and mitigate damages in the future as India is prone to it. As a torchbearer for other initiatives to follow, a model plan – a disaster preparedness module was made, the details of which are delineated under the design of the study.

## II. DESIGN OF THE STUDY

The tsunami triggered by an earthquake that struck the south Indian coastline had left deep scars such that, the word which was an unknown phenomenon has become the stuff of common parlance. This natural calamity had rendered many a households helpless and homeless. In terms of human suffering and loss of property and assets, it was one of the worst calamities the country had recorded. As per the Tamil Nadu Government reports, among the 8010 human lives lost due to the earthquake – triggered tsunami, Nagapattinam (6065), Kanyakumari (828), Cuddalore (617) and Chennai (206) ranked high in death toll. As far as the data on shelter damage goes, Nagapattinam (39,941), Kanyakumari (31,775), Chennai (17,805) and Cuddalore (15,200) recorded maximum catastrophe. Comprehending the dimensions of the catastrophe, routing relief and rehabilitation measures was not only time consuming but also one which warranted concerted efforts from all quarters of people around the globe. The striking feature was the spontaneous and substantial support and assistance that flowed from NGOs and other volunteers.

The effort was on rehabilitating the survivors. Though only 16 months had passed after the tragedy (when the study was undertaken), reconstruction activities had been expedited on a real 'war-footing', despite another calamity, in the name of floods, that affected the same coastline. Among the major measures undertaken in full swing, construction of permanent shelters for those who had been housed in interim shelters had received top priority. Hence a study on the "Housing Conditions of the Rehabilitated Victims" was launched, identifying 10 samples each from two villages of the most affected areas, namely, Chennai, Nagapattinam, Cuddalore and Kanyakumari. Nature and uniformity of response and readiness to disclose only a few facts (found from pre-testing) which posed a constraint enforced the selection of these samples (80 in numbers). To understand the modus operandi of the activities of the NGO, ten NGOs who were actively participating in this reconstruction work were interviewed. Based on the light of these surveys an attempt at bringing out a model house design for dedicating and creating awareness

among survivors for preparedness was scheduled. The design of the study studied the following aspects.

### A. Thematic Analysis of the Interim Shelters

The contribution of NGOs was earmarked as one of "Rescue operation" through "emergency/temporary shelters for survivors" during the emergency phase of disaster, but as a pre-emptive measure to permanent structures. For the pragmatism revealed by umpteen numbers of NGOs, who have in all earnest embarked on this noble mission, it is imperative that some feedback about the interim shelters, also provided by them be delivered as a token of appreciation.

Using a structured checklist details pertaining to the fulfillment of the pointers leading to the satisfaction derived from the provided interim shelters was arrived at.

### B. Profile of Philanthropists and rehabilitation efforts

The unexpected tsunami had took the toll on shore-line dwellers on the one hand and on the other had evoked unprecedented response from different quarters, bearing witness to the humanitarian spirit prevailing in the society. Shelter was given topmost priority in the rehabilitation process in Tamil Nadu, which not only provided a roof but also ensured safety from future disasters. The contribution of NGOs towards rehabilitation was found appreciable. From among the 104 NGOs existing in the four locales, 47 had expressed willingness but only 21 were found to be actively participating in the endeavor [5].

At this juncture it was found inevitable that the dwelling design evolved by the NGOs and the execution of the same was evaluated for their compliance both to set standards and user-compatibility. As these would also enable gaining some useful tips and feeling the pulse of the users, the model of the houses dedicated by ten NGOs who displayed active participation in this noble, national reconstruction process, to the affected persons were evaluated. Highlights through reports and, the popularity of these NGOs among the affected public on a casual visit to the places helped in their selection.

Personal visits to the shelters being constructed by the NGOs during the survey helped increasingly to observe the types of dwellings designed by them. To gather specific information about their pragmatic efforts, the investigator resorted to a verbal conversation with the personnel-in-charge in all the four locales on the one hand and by administration of a structured schedule, on the other, to comprehend their modus operandi. A pilot study comprising two NGOs in Chennai helped to fine tune the schedule designed to collect data for the project.

### C. Drafting a Model Dwelling Design Alternative

The survey of the samples threw light on a few felt lacunae expressed in terms of the shelters provided to them. Similarly enquiry of the representatives of the NGOs also revealed that the plan of shelters dedicated to the survivors was not absolutely in unison with the prescribed guidelines given by the Tamil Nadu Government. To join hands with the 21 NGOs in the selected locale who have contributed their mite to the welfare of the affected groups, an earnest effort was made to bring out a model plan structurally compliant with the established standards projected by the Revenue Administration, Disaster Management and Mitigation Department, Government of Tamil Nadu, on the following lines

- Drafting of a Model Plan and its Details
- Evaluation of the Design for Social Responsiveness and Disaster-resistance
  - Rendering Soft and Hard Copies of the Plan
  - Dedicating the Model Plan for a National Cause
  - Drafting of a Model Plan and its Details: A model of a low budget house plan was drafted keeping in view the byelaws put forth by the Government. An estimate of the plan was also done with the assistance of an engineer (period of study-2006)

The plan was envisaged to be square shaped with a plinth area well within the limits prescribed, allocating space for **sleeping, cooking and personal activities**. Provision for both green and brown shelter that is, environment and infrastructure was considered in the planning process.

- Evaluation of the Design for Social Responsiveness and Disaster-resistance: This was done in two phases. For user's compatibility, samples – women from the chosen villages were handpicked at random (63), the plan was presented before them and viewpoints were recorded. For the second phase, three architect/engineers from Coimbatore were chosen adopting convenience sampling. Based on the opinion expressed by both the groups, the model plan was modified and finalized.
- Rendering Soft and Hard Copies of the Plan: To make the endeavor safer for handling and to add a charm to the issue a hard copy in the form of a booklet with all necessary clippings on plan and its details, need for disaster resistant structures, sound principles of structural disaster mitigation and pointers for safe construction was published. Similarly as the present era is advocating more on paperless management, bringing out a soft copy form (a CD) of the data plus the details was also envisaged.

### III. SALIENT FINDINGS

*A. Portray of the Survivors: Information gathered on this aspect is summarized under:*

*The After – math (of Tsunami): Disaster-Response:*

- Social Mapping of the concerned group revealed that they had endured all the three impacts of a disaster, namely, direct, indirect and intangible losses.
- Among direct losses, all of them had lost their shelter and 15-20 per cent among all the samples (from the entire locale) had lost family members to the killer waves. Ten, 20, 15 and 15 per cent of the homemakers were also widowed by Tsunami at Chennai, Nagapattinam, Cuddalore and Kanyakumari respectively.
- Indirect influences are discernible from the loss of livelihood, personal possessions, identity cards (ration cards, certificates), banking instruments and documents.
- On the intangible side, they reported to have lost their self esteem, identity, health, economic security and psycho-social safety.
- These impacts had in turn effected drastic changes in their meal preparation and consumption pattern, expenditure and socialization. Expenses on health care were found to have escalated because of the trauma and agony they had suffered.

*Physical Resources:*

- Except the inhabitants in Samanthanpettai who were housed in a permanent shelter provided by an NGO, all others regretted the loss of their houses to the tides and expressed inconveniences felt with the interim shelters (Fig.1)
- While all had equal access to water supply, 50 per cent from Kanyakumari and cent per cent from Nagapattinam grudged the distance to be walked to reach ration shops, work spots and retail shops.
- For one half of the population from all the locales, bus stands were quite far both before and after tsunami.
- Access to friends' house were nearer, while relatives' houses were far placed.
- Though toilets were found in all settlements, safety to use at night (girls & women) and provision of common toilets for both men and women were cited as problems. This was highlighted as a major factor for discontentment.
- Police booths were stationed nearer to settlements but fire stations were quite remote. Considering materials used for construction (flammable) and relating their living pattern to high risk tendency, the arrangement was found to be quite dissatisfactory.
- Relocating the settlements, which hindered with their livelihood, was cited as a prime factor for discontentment.
- The samples were not happy with the 'multipurpose room' provided as a house which denied the basic principles of, ventilation, spaciousness, privacy, safety and absence of storage spaces.

- Lack of private/public open spaces for livelihood activities was also reported.
- Having lost their livelihood avenues, the interim arrangements made (catamaran and fishing net to be shared by two families) were not up to their expectations.
- Apart from the trauma of losing their kith and kin, the loss of personal documents, ration cards, identity cards, LIC receipts, banking instruments and certificates of merit (education) compounded their grief.

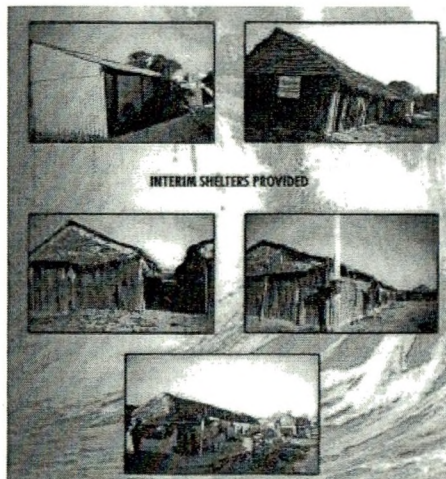


Fig.1 Interim shelters provided

- Ultimately they stated that their lives were not safe and secure with such make - shift arrangements made for physical resources as well as livelihood avenues. Evidently the shelters provided were not 'socially responsive'.

- Naturally their economic safety also has been jeopardized in the wake of the tsunami.

Earlier the societies were egalitarian, as nature did not discriminate much. However, in post tsunami, household level inequalities had become sharper. Thus the urgent and immediate concerns of the people presently centered on security, proper housing and most importantly livelihood.

*B. Panoply of Dwellings given by the NGOs-Rehabilitation:*

All the NGOs had currently housed their prospective beneficiaries in pucca interim shelters (Fig.2).

- As a preemptive measure the Revenue Administration, Disaster Management and Mitigation Department, under the aegis of the Government of Tamil Nadu, had charted out

guidelines in elaborate when these become obligatory for all involved in building activity to abide by the stipulations put forth for the various components of a building (Appendix 1).

- These guidelines had been brought out mainly with the objective of "preventing and mitigating" the impact of disaster on buildings in future.

As these had been made mandatory for all those involved in rehabilitation service, an attempt was made to find out how far these have been satisfied in the houses constructed by the NGOs.

- From among the NGOs, currently existing in the selected locale, only ten had committed themselves for rehabilitating tsunami-survivors. Hence the details of the plans being executed into construction activity were elicited by case study method. Analysis of the dwelling design and response to a checklist administered on the samples revealed the following.



Fig. 2 Rehabilitation structures provided by the NGOs

TABLE III

PROFILE OF THE HOUSES DEDICATED BY THE NGO'S

NGO identity	Houses planned	Houses Completed	Plinth Sq.ft	Facilities Provided	Deviation from government Guidelines
1	2150	300	325-350	Hall, bedroom, verandah, kitchen, toilet	Ratio for concrete mix 1:1, 5:3 instead of 1:4:8
2	1300	397	400	Five small	Distance

				rooms each	from seashore < 500 m from seashore •Height of plinth from foundation <0.6m •Walling ratio for plastering <1:5
3			160	4 small rooms inclusive of a toilet	•Soil selected – clayey soil •Multi storied structures •Lack of provision for expansion
4			180	A multi-purpose room	•Lack of storage facility •Lack of provision for expansion
5			332	Hall, bed room, kitchen, toilet	•< 1 km away from old settlement •Ratio for foundation concrete mix 1:1, 5:3 instead of 1:4:8
6			340	Hall cum pooja, bedroom, toilet	•Plinth height - >0.6m •Not used load bearing walls •No kitchen counter
7			350-400	Hall bed room, kitchen, toilet	•Use of local building materials •Ratio of mortar mix used - <1:6
8			350-400	Hall bed room, kitchen, toilet	•Weathering course was not provided •Use of concrete mix – ten than 1:4:8
9	300	none	350	Hall bed room, kitchen, toilet	•Sitting of houses nearer to seashore – less than 500 m
10			180	Single	•Lack of

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C. Rehabilitation Shelter (NGO) Vs Social –Cost Benefits:

Response to an enquiry into the satisfaction derived by the sample in lieu of the shelters provided is summarized as under:

- All the samples irrespective of locale expressed satisfaction on socio-economic concerns fulfilling livelihood aspects. But beneficiary participation, spatial relationships between families and provision for common activity spaces were not up to their expectations.

- As regards physical and environmental aspects ensuring of infrastructure alone was received well. Dissatisfaction prevailed for being relocated and local environment not being congenial.

- Technical and structural concern like site and services, thermal comfort, protection, planned activity spaces, interface buffering evoked mixed feelings.

- All the samples irrespective of the locale were totally dissatisfied with the functionality of the houses (interim shelters) and principles of planning followed in their construction.

- Option given to spell out the inadequacies felt with the shelters brought forth provision of claustrophobic multipurpose rooms, lack of storage facility, livelihood activity spaces, safety to use toilets at night and unsanitary conditions as pointers.

- Despite the trauma, the study has brought to light that the survivors are in a constant motivated state and Maslow's concept of human behaviour of 'wanting for more that is still better' has been proved good. It has also been a litmus test to feel their pulse as to what they expect in a dwelling.

D. Panorama of the Model Plan – Disaster Prevention and Mitigation:

A natural urge to contribute one's mite to a national cause as a researcher from an esteemed University, promoted drafting of a model house plan suitable for resisting disasters. The details pertaining to the plan are furnished below and in Fig.3, Fig.4 (a) & (b).

*1. Salient Features:*

- The plinth was decided as 32 Sq.m enclosing space for a small hall, bedroom, kitchen and a toilet.
- The plan was complete with provisions made for good ventilation (ample windows) plumbing, sanitation and drainage facility
- The estimate drawn (period of study-2006) on its favor amounted to Rs. 2, 14,550/- (devoid of land cost) (Appendix-2)
- The plan was found to satisfy all the principles of planning namely, aspect, prospect, circulation, roominess, flexibility, sanitation, ventilation, etc.
- While the shelters promoted by NGO's gave insight into the plinth, number of rooms, cost of construction, duration of construction and the prevailing trend in execution of project, survey of the beneficiaries in the interim shelters threw light on what they expected.
- The model plan suggested was thus designed to be one that blends with the viewpoints of both the groups, already in the field.
- An added factor was that, the plan was framed to comply verbatim with the guidelines prescribed, by the state Government.

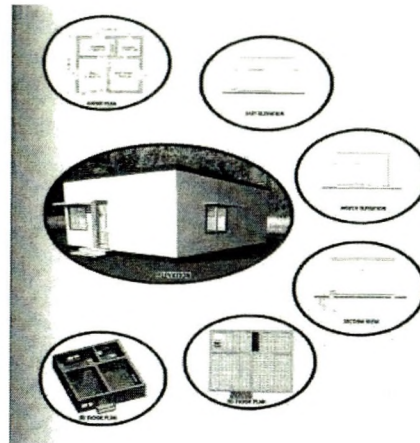


Fig.3. Details of the model plan.

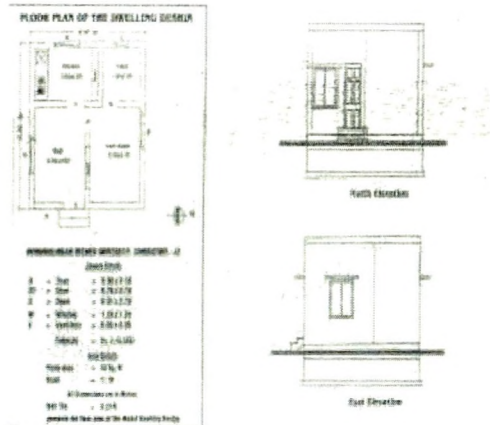


Fig.4 (a). Working Models.

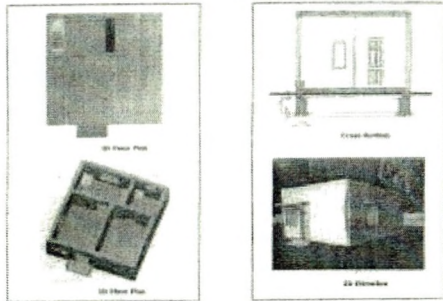


Fig.4 (b). Working Models.

## 2. Technical Details

- Aspect ratio is less than 3
- Devoid of structural ornamentation
- Shallow foundation given is approximately 1.5m deep foundation (coastal regions).
- Plinth height is 0.45m
- Continuous reinforced concrete is suggested for footings
- Seismic bands at window, sill and lintel level are provided
- Long walls have been avoided
- Vertical and horizontal RC bands for earthquake resistance have been provided
- Good standard (quality) mortar has been suggested
- Load bearing walls are at least 200mm
- Wall thickness is maintained as 230mm
- Wall height is 2.9m
- Roof is flat
- Quality materials are suggested
- A roof band is provided
- Weathering course is provided
- Orientation of the suggested plan can be inclined to any angle such that the opening (façade) does not face the sea
  - Horizontal distance between doors and windows and their length and width ratio is properly maintained
- Materials are suggested as per Government guidelines
- Flooring is compacted well
- Proper drainage is provided
- Quality control is highlighted

## 3. Limitations:

- Provision of a terrace with a parapet wall for functional use of the rooftop was purposely omitted, both to practice economy in construction and to reduce the load on the foundation.
- Future expansion also has not been envisaged.
- Pallam sand has been advocated for foundation.

- Avoidance of ornamentation of any sort.
- The plan was drafted for locally existing soil quality (black cotton soil)
- In the 3D module attached, placement for a wash basin has been made (owner's preference) for which cost has not been included in the estimate. It was just to show placement.

## 4. Fulfillment of prescribed Guidelines:

The construction details were compared with the prescribed guidelines for constructing disaster-resistant houses. The details are summarized as under.

The model plan compared well with the guidelines on all scores except in the use of the ratio for concrete mix in foundation – 1:5:10 for 1:4:8, absence of cantilever and, plinth height retained as 0.45m.

## 5. Practical Suggestions:

- Use of locally available materials can help bring down the cost of construction.
- Based on soil testing done in respective sites, the foundation details can be modified.

## 6. Opinion – Sharing:

The beneficiaries, when presented with the plan on paper, appreciated the size, shape and provisions made for attached bath cum toilet, storage facilities and cooking counter. They agreed that the house will be well lighted, ventilated, affords privacy for activities and assures the much 'longed for' safety within the interiors.

The experts, while appreciating the model plan as well as the gesture, stated that the plan was good, has meted out all requirements and the estimate was nominal and rational. They agreed that the plan compared well with the Government stipulation and satisfies the requisites to be called as a Disaster Resistant model in terms of planning aspects.

As the plan proves to be cost effective and eco-friendly too it can be concluded that the suggested dwelling design can help prevent and mitigate the impacts of a disaster. Moreover as it satisfies the needs of the users, it can really be socially responsive too.

## 7. Dedication:

- The model plan in all forms as elevation, floor plan (2D and 3D), and cross section (2D and 3D) were drafted on paper and the same was done on Auto CADD.
- The plan was rendered both in hardware and software

forms.

- The plan (software) and a booklet on Disaster prevention measures in Tamil Nadu were sent to Joint Commissioner (Relief and Rehabilitation) O/o Special Commissioner and Commissioner for Revenue Administration, Chennai as a dedication, to the survivors and the Tamil Nadu state in the name of our University. A feedback is awaited.

IV. CONCLUSION:

The survey done to understand the status quo of the survivors, and one to comprehend the construction activities of the NGOs motivated interest in furthering the study by dedicating a plan fit for Disaster – Resistance and for campaigning among the groups to create general awareness on disasters. As shelters are the worst affected, the booklets published added more charm to the study.

It is not an end; it has to be the beginning for further researches to come, though the study has thus met the set targets. It is fervently hoped that humanity should not face any such calamity in the future. Still, as the adage goes 'Prevention is better than cure', let us all pledge to lesson the impacts by inculcating in ourselves the value of "preparedness" to prevent and mitigate disaster.

V. APPENDIX

Appendix – 1:

General guidelines to ensure disaster resistance in dwelling designs:

- Construct on an elevated ground level
- Construct on stilts or on raised earth mound if natural elevated ground is not available
- Opt for a square or rectangular plan
- Go in for symmetric buildings as they are more stable
- Adopt cluster arrangement to row type buildings
- Provide horizontal beams at ground level and plinth level
- Provide adequate foundation- preferably give pile foundation in weak / loose soil
- Ensure that the length of the wall does not exceed eight times the thickness (L/H ratio)
- Provide a sheer buttress wall if necessary to reduce the L/H ratio in a room with lengthy wall
- Restrict walls that are too long or too high
- Maintain standards for load bearing walls
- Provide continuous lintel band if possible
- Maintain height less than 3.0 m for each storey

- Anchor projections (cantilevers) by supporting beams
- Maintain width of openings (space occupied) to be less than one half of the total length
- Leave adequate space between doors and windows and from edge of walls

Additional factors for tsunami prone areas:

- Build in a valley to protect the house from high wind velocities
- Shield the house from high winds by permeable barriers such as tall trees
- Use zig zag planning to curtail wind tunnel effect
- Orient shorter face of the building facing wind direction
- Avoid large openings on the sea side
- Allocate distance from shore to be above 500m
- Elevation should be +5m above MSL
- Orientation (façade) should be away from the sea

Appendix – 2: Estimate

Detailed and Abstract Estimate for Construction of the Proposed Residential Building

Description of Works	No	Length	Breadth	Depth	Qty	Unit	Rate (Rs.)	Amount (Rs.)
Earth work excavation for foundation of all soils except hard rock and rocky species which requires plastering and removing the earth outside the campus through lorry All-round wall Front Steps	1	32.75	0.75	1.50	36.84	Cu.M	90.00	3467.81
	1	1.50	0.75	1.50	1.69			
	1	1.50	0.75	1.50	38.53			
Plain cement concrete 1:5:10 mix using 40 mm hard blue granite metal 4" thk for leveling course in foundation trenches including charges for scaffolding, curing etc., All-round wall Steps	1	32.75	0.75		24.56	Sq.M	160.00	4110.00
	1	1.50	0.75		1.13			
	1	1.50	0.75		25.69			



windows with two coat of enamel paint of approved quality over one coat of primer	4.6	0.90		2.13	8.82				
	2.3	0.75		2.13	3.67				
	9.2	1.22		1.22	13.69				
					26.19	Sq.M			
Doors (2X2.3)								70.00	1833.00
(1X2.3)									
Windows (4X2.3)									
Supplying and laying of weathering tiles	1	5.11	5.41		27.65	Sq.M	230.00		6358.37
Providing kitchen table top						L.S			1000.00
Providing kitchen shelf and Bedroom shelf						L.S			3000.00
Provision for plumbing, sanitary, sump and soak pit						L.S			10000.00
Provision for Electrification						L.S			5000.00

Total Amount Rs. 214553.58

Say Rs. 214550.00

(Rupees Two lakhs fourteen thousand five hundred and fifty only)

#### VI. ACKNOWLEDGMENT

The cooperation extended by the samples and the NGOs involved in rehabilitation endeavors is deeply appreciated. The authors thank the Management of Avinashilingam Deemed University for granting permission to undertake this research work. The assistance rendered by the University Engineer and the CADD Centre is also acknowledged.

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## Towards An Integrated Model For Academia-Industry Interface In India

First Vinay K. Nangia, Second Cashmira Pramanik

**Abstract**— Academia-industry relationship is not like that of technology donator-acceptor, but is of interactive and collaborative nature, acknowledging and ensuring mutual respect for each other's role and contributions with an eye to attaining the true purpose of such relationships, namely, bringing about research-outcome synergy. Indeed, academia-industry interactions are a system that requires active and collaborative participations of all the stakeholders.

This paper examines various issues associated with academic institutions and industry collaboration with special attention to the nature of resources and potentialities of stakeholders in the context of knowledge management. This paper also explores the barriers of academia-industry interaction. It identifies potential areas where industry's participation with academia would be most effective for synergism. Lastly, this paper proposes an integrated model of several new collaborative approaches that are possible, mainly in the Indian scenario to strengthen academia-industry interface.

**Keywords**— academia-industry, interface, knowledge economy, technology transfer.

### I. INTRODUCTION

THE dawn of 21st century is witnessing the advent of a new knowledge-driven society and a quantum leap in higher education. Higher education refers to a level of education that is offered at academies, universities, colleges, seminaries, institutes of technology, and certain other collegiate-level institutions, such as vocational schools, trade schools, and career colleges, that confer academic degrees or professional certifications. There is a rapidly growing demand for a higher education in the today's world because it serves various important functions in our society, the foremost being creation of knowledgeable individuals who will provide service to the society. With globalization taking place, the job market has become even more competitive. Now, a person not only has to compete for a job with the people from his own community or country but also with the people who emigrate from other countries. So what is it that will distinguish one from all other

competitors? Of course it is one's additional skills, knowledge and a college degree. Indeed, many of the Indian universities have failed to fulfil this purpose. The recurring demands of skilled and specialised manpower from the industrial sector are not being met as a large section of graduates lack the necessary critical thinking and analytical skills required by the industry. Nowadays, a vast majority of higher education planners and academics, throughout the globe, has been trying to link universities and other research institutions with industries. Universities can boost the value of products in the form of knowledge; industry can supplement the value of university in the form of funds. The National Policy on Education [19] in India has put great emphasis on the need for university-industry interaction. However, in spite of so many efforts undertaken by the Center and State governments, university-industry interaction has failed to prove a noticeable progress up till now. It still remains superficial and limited to a few premier institutions.

How can one define academia-industry interface? A good definition could be that academia-industry interface is characterised by the interactive and collaborative programme between academic institutions and industrial sector for the attainment of certain reciprocally beneficial purposes and missions. Interdependence between academia and industry should be intensified to fulfil necessity for sustenance and innovation in their own domains. Academia-industry interface can be set up at diverse levels with different degrees spanning from mere consultations or visits to meticulous researches. There is a need for paradigm shift in the attitude and approach of both the entities for obtaining mutually beneficial objectives and goals. Despite the different mechanisms of academia-industry interface, there is ambiguity whether the relationship is considerable or only partial in nature. It is unavoidable that the academic sphere, industrial sector, and government machinery should form synergy cooperating, collaborating, and facilitating with each other to combat the new challenges of the global economy. This universal strategy is a must for economic viability and all round development of the country.

### II. RESOURCES AND POTENTIALITY OF STAKEHOLDERS

To make academia-industry interface a grand success, all the stakeholders- academic institutions, industry, and government should collaborate and interact with their own resources and potentiality, as it can be a 'win-win' partnership.

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Article #	TABLE OF CONTENTS -PART II-	Page
25	Simulation of Heat Transfer in the Multi-layer Door of the Furnace <i>U. Prasopchingchana</i>	150
26	Simulation Modeling of Manufacturing Systems for the Serial Route and the Parallel one <i>Tadeusz Witkowski, Pawel Antczak, Arkadiusz Antczak</i>	156
27	Influence of Artificial Roughness on Heat Transfer in the Rotating Liquid Flow <i>T. Magrakvelidze, N. Bantsadze, N. Lekveishvili, Kh. Lomidze</i>	162
28	Serum Nitric Oxide and Sialic Acid: Possible Biochemical Markers for Progression of Diabetic Nephropathy <i>Syed M. Shahid, Rozeena Shaikh, Syeda N. Nawab, Shah A. Qader, Abid Azhar, Tabassum Mahboob</i>	166
29	Comparative Experimental Study of Ambient & Oven Dry Cured Geopolymer Concrete <i>Sunil Kumar Tengli, Yeshwant PrabhakarPawar, M.S. Kalappa</i>	170
30	Coverage & Connectivity Problem in Sensor Networks <i>Meenakshi Bansal, Iqbal Singh, Parvinder S. Sandhu</i>	178
31	Enhanced K-Nearest Neighbor Algorithm <i>Dalvinder Singh Dhaliwal, Parvinder S. Sandhu, S. N. Panda</i>	181
32	A 16Kb 10T-SRAM With 4x Read-Power Reduction <i>Pardeep Singh, Sanjay Sharma, Parvinder S. Sandhu</i>	186
33	Parametric analysis and design of Regional Language Character Mapping in Education <i>Hardeep Singh Jawanda</i>	191
34	Distributed Denial of Service Attacks In Mobile Adhoc Networks <i>Gurjinder Kaur, Yogesh Chaba, V. K. Jain</i>	195
35	Bayesian Network Based Intelligent Pediatric System <i>Jagmohan Mago, Parvinder S. Sandhu, Neeru Chawla</i>	198
36	Cloud Computing Databases: Overview of Latest Trends and Architectural Concepts <i>Tarandeep Singh, Parvinder S. Sandhu</i>	203
37	Two-level Transplant Evolution for Optimization of <b>General Controllers</b> <i>P. Osmera, R. Weisser, M. Seda, J. Roupec</i>	207
38	FRC __ A New Sustainable Option for ConstrUction to Mitigate Eartquakes <i>P.J.Sasturkar</i>	215
39	Biological Data Integration Using SOA <i>Noura Meshaan Al-Otaibi , Amin Yousef Noaman</i>	221
40	Web Page Watermarking: XML files using Synonyms and Acronyms <i>Nighat Mir, Sayed Afaq Hussain</i>	227
41	Evaluation of correlation between morphphysiological characters in maize hybrids by kernel yield using Path Analysis <i>Mehdi Zirehzadeh, Mohammad Shahin , Najaf Hedayat</i>	231
42	Lattice Boltzmann Simulation of Binary Mixture Diffusion Using Modern Graphics Processors <i>Mohammad Amin Safi, Mahmud Ashrafizaadeh, Amir Ali Ashrafizaadeh</i>	236
43	Study of Current Sheath Velocities in Tridimensional with Sahand Plasma Focus <i>M.A. Mohammadi, H.Alinejad , A.Piri</i>	244
44	Micro environmental concrete <i>M.Lanez, M.N.Oudji, A.Bali</i>	247
45	Using Biogas energy as an alternative resource of energy in building <i>Mehdi Reiszadeh</i>	252
46	Two Dimensional Simulation of Fluid Flow and Heat Transfer in the Transition Flow Regime Using a Lattice Boltzmann Approach <i>Mehdi Shamshiri, Mahmud Ashrafizaadeh</i>	256
47	A 'Socially Responsive' House Plan as a 'Disaster Preparedness' Module <i>Visalakshi Rajeswari, M. R. Sree Jyothi</i>	264
48	Towards An Integrated Model For Academia- Industry Interface In India <i>Vinay K. Nangia, Cashmira Pramanik</i>	275

49	Modeling of Catalyst Deactivation in Catalytic Wet Air Oxidation of Phenol in Fixed Bed Three-Phase Reactor <i>Akram Golestani, Mohammad Kazemeini, Farhad Khorasheh, Moslem Fattahi</i>	287
50	An Experimental Design Approach to Determine Effects of The Operating Parameters on The Rate of Ru promoted Ir Carbonylation of Methanol <i>Vahid Hosseinpour, Mohammad Kazemeini, Alireza Mohammadrezaee</i>	293

- Articles in published national conference proceedings with ISBN

Chapter/co author	Title of conference	Editor(s)	Publishers details	Year
Energy Labelling – An Allegorical Symbol Of Common Interest Of Indians And Canadians	Ecology, Culture, Ethnicity and Literature: Canada and India	Selvam	Excel India Publishers, New Delhi.  <i>ISBN 978-81-909633-7-4</i>	2011 Pp: 310-324
Ergonomics of traditional looms – occupational health hazard among women weavers ( <i>Kangjam Victoria Devi</i> )	Occupational health And Stress (OHAS – 2011)	R.I. Sathya	Excel India Publishers, New Delhi  <i>ISBN: 978-93-80697-66-6</i>	2011-03-27 Pp. 149 - 152
Kingpin Milieu Of Safety And Occupational Health Hazards- The Unorganizes Sector And Women Labourers	Occupational Safety And Stress (OHAS – 2011)	R.I. Sathya	Excel India Publishers, New Delhi  <i>ISBN: 978-93-80697-66-6</i>	2011 Pp.116 - 120
Occupational health and safety – plight of women in construction industry ( <i>Sagufta Ahmed</i> )	Occupational Safety And Stress (OHAS – 2011)	R.I. Sathya	Excel India Publishers, New Delhi  <i>ISBN: 978-93-80697-66-6</i>	2011 Pp. 133 - 138
Impact of injuries in women – prospects for ergonomic intervention ( <i>Sarasvathi. V</i> )	Occupational Safety And Stress (OHAS – 2011)	R.I. Sathya	Excel India Publishers, New Delhi  <i>ISBN: 978-93-80697-66-6</i>	2011 Pp. 145 -148
Relevance of the seven habits paradigm to cumulative learning sequence	Quality improvement concepts and their implementation in higher educational institutions	J. Ravichandran	Shri Garuda Publications Coimbatore  <i>ISBN: 978-81-907870-4-8</i>	2009 Pp:171-174