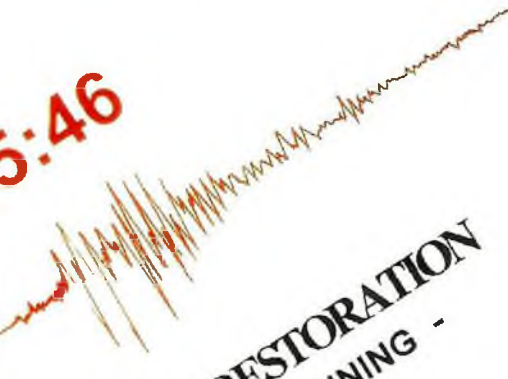


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FROM THE COLLAPSE TO RESTORATION
- ALC DISASTER - PROOF PLANNING -

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The structure built with ALC Quake - resistance property stands intact with adjacent building seen in total destruction.



1. Lessons from the Osaka-kobe Awaji Street Earthquake

An incredible crumbling of city. At pre-dawn darkness, on Jan. 17, 1995, an earthquake measuring 7.2 on open Richter scale, with epicenter located on northern part of Awaji Island struck Osaka-kobe area, causing a great disaster. The devastation, widely shown in real time TV broadcast, depicted the scenes of the city in ruin, with streets engulfed in flames.

What heightened the sense of tragedy was the sight of onlookers, and their attitude: an utter indifference with which they viewed the raging flames around them, without making any effort to fight the conflagration.

Shown continuously on TV were the scenes of upturned highway almost one kilometer long, the blue sky showing through a gaping shinkansen rail bridge span that was missing, numerous high-rise buildings leaning in acute angles that defy sense of balance: those incredible scenes of collapsed city were shown non-stop.

The Osaka-kobe Awaji Street Earthquake: this vertical motion urban earthquake caused us to recognize the weakness of modern city, and the need to improve an inadequate existing disaster preparedness planning.

Kobe city, the city that single-mindedly pursued urban modernization: the mountains levelled, the sea filled to make a new city on a newly created island port, on the Island: even the buildings constructed of most advanced materials

in these area suffered the damages. If you turn your attention to the city center, you will see a large number of wooden structures laying squashed, as is smashed by one giant stroke. A group of buildings leaning in angles that defy one's sense of balance, a puzzling view of crumbled mid-section of still standing high-rise building, damaged lower section of spiral staircase, these scenes conveyed sense of tragedies in epic proportion.

Establishing the Safety and Anti-disaster standard

In the era of so called "Age of City" where almost half of population is concentrated in urban area, a disaster of this kind poses serious problem not only for such vital public utilities as: Electricity, water, gas, as well as communication networks, but also presents the construction sector with myriad problems.

We, the ALC industries have taken this warning signal seriously enough to mount an extensive damage assessment and survey in order to counter future disaster and to ensure safer and higher anti-disaster ALC product incorporating new technological advancement.

Restoration in progress. ALC are being utilized on July 7, 1995.



2. Surveying the disaster area

ALC, using all resources at hand, conducted series of survey three times on 1,000 buildings in order to assess the damages sustained by the Quake.

Areas surveyed were those that suffered the most damages, in order of severity: Kobe city, Nishimori, and Naomi. The surveys were confined to ALC structures.

Mode of surveys consisted of: observation on foot, principally of visual inspection of exteriors, to evaluate damages relative to structure surveyed as a whole.

Damages, in ascending order of severity; Nishnomi area, Aoki and Sannomia, degree of damages suffered by each zones are clearly distinguishable. Results of those surveys are shown below.



Aoki District



Nushinomi District



Sanomia District



Naganichi District

Summary of Survey

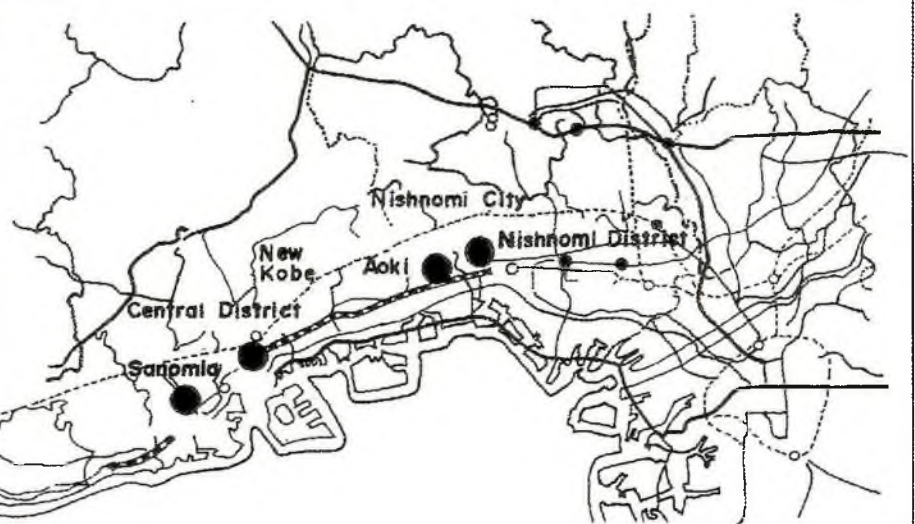


ALC Bldg. aftermath of quake

District Surveyed

- Sanomia District (Sanomia City around Sanomia area)
- Aoki District (Kobe City)
- Nishnomi District (Kobe City)

- Nakata District (Kobe)



Survey Details

1st Inspection (1.31 - 2.2)
Three areas were surveyed during the course of three days. Total of 369 buildings were inspected.

2nd Inspection (2.13 - 2.17)
Inspection focused especially on the differences in degree of damages observed between the construction dates.

3rd Inspection (3.29 - 3.31)
Those subjected to 1st and 2nd inspections were subsequently re-examined for additional study.

1. Degree of damages relative to location.
2. Exterior tiled ALC building.
3. Example of ALC fire - proof property.
4. High-rise building and ALC.



1. Investigating the Quake - resistance property

1.) ALC building

The survey results have shown the ALC to be highly resistant to quakes, and is able to withstand extreme shocks such as one experience by an earthquake on 7.2 open Richter scale.

Except for those that were totally destroyed and the ones that clearly show structure deformations, ALC buildings developed only minor cracks.

Due to its light weight, ALC, a concrete product with 0.5 specific gravity imposes less load stress on a structure, thirty and more years of performance in field application have proven that this is a high-quality construction material with high safety standard that also possesses quake-resistance property.

Damages to ALC building are shown on the right.

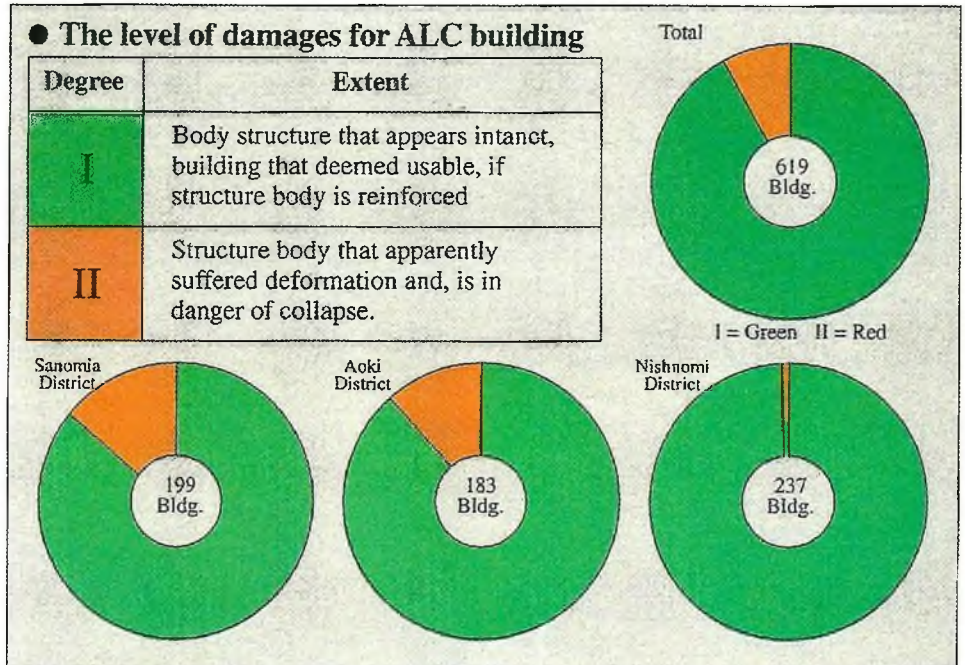
ALC structure design standard

This standard, formulated in 1967, was based on the construction standard regulation No. 38. and was formally endorsed by the Ministry of Construction, defining the construction standards for ALC building.

In 1981, a revised construction standard incorporating the newly adopted quake-resistance regulation was put into place. The anti-quake property was the main consideration for the revised Law passed by the Ministry in 1983.

ALC Attachment Method Standard

At the time of construction design standard revision, the standardized method of attachment devised by the ALC Association was accepted by the Ministry as "Design standard".



Shop-cum resident : degree I



Family mart : degree I



ALC exterior wall of mid-size office building : degree I



ALC wall of mid-size mansion : degree I

2.) ALC panel

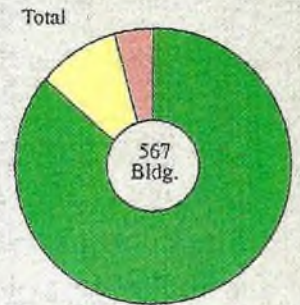
Degree of damages inflicted on ALC panel and the situation in parts of the disaster zone is shown on the right: Damages occurred on different panel structure are: lateral portion, entry/exit area, Lengthwise adjoining area, around the area surrounding the openings.

Cause of the damages are:

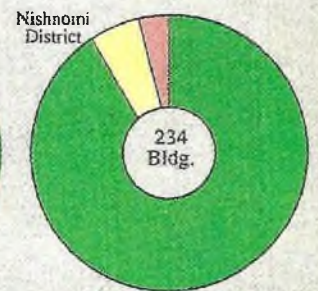
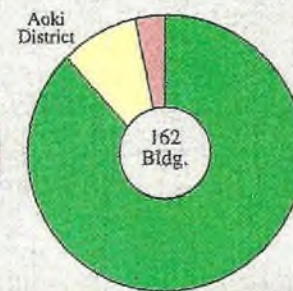
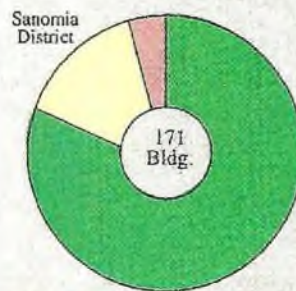
- Collision by the adjacent building
- Collision by the heavy object inside the building
- ALC panel that was attached by the outdated method before the adoption of new attachment method on construction, etc.

● The degree of ALC panel damage

A	Undamaged panel that developed minor cracks in part of panel, usable upon repair.
B	Ones that developed cracks in several part of panel: usable upon repair. Damaged panel. If the attachment portion of panel is repaired.
C	Damage beyond repair



A = Green B = Yellow C = Red



ALC building with Tiled ALC exterior wall : degree A



4 storey of Orthopedic Clinic : degree A



4 storey ALC building, clinic/resident's : degree A

Tiled ALC

Recent years, for aesthetic reasons, and for enhanced durability, the use of Tiled ALC in exterior finishing have noticeably increased in numbers.

The results of a recent survey indicated that almost no damages were observed on the building wall, where tiled TALC panels were applied using proper methods.



ALC mansion : degree A



Communal resident wall : degree A

THE LEVEL OF DAMAGES FOR ALC BUILDING

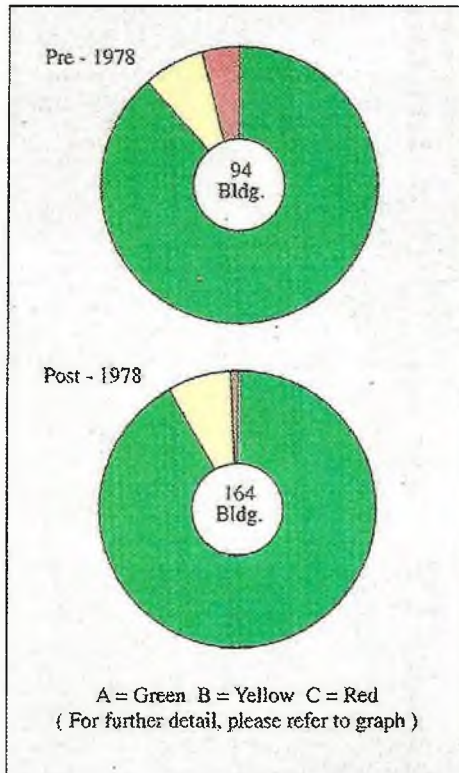
3. Introduction of new quake resistance design

The lesson learned from the earthquake of 1978 forced us to reconsider anti-quake standard and this has resulted in an adoption of new anti-quake construction planning, as construction standard were extensively revised.

Structure design standard for ALC construction method was devised with higher quake-proof property in mind, 1983.

In this survey, the attention was focused on the differences between the building construction before and after the adoption of the revised law.

The result, as graphs on the right indicate; degree C, denoting no possibility of re-occupancy, is very small in numbers and proves clearly that the attachment method recommended was correct.



ALC Penthouse atop a terminal building (Degree A)



ALC Exterior wall of a plant (Degree A)

4. Results of quake-proof construction method

According to a recent survey conducted on the building constructed with the method adopted for ALC quake-proof construction standard, no damages were visible, proving the superiority of quake proof finishing.

Additionally, ALC panels were used extensively in and around elevator openings, staircase casings, and in some partitions of high-rise buildings.

In this survey, it was not possible to verify any damages that might have occurred in the area covered with ALC finishing material, because of the simple visual inspection methods used.

► Pictures on the left show the building, located near the disaster area that was constructed in 1994, showing a beautiful surface structure unmarred by any damages.



2. Fire - proof property

On this occasion, because of the heavy concentration of old wooden housings in Nakata district, great conflagration occurred due to intermittent fire - fighting activities, the fire, raging for two days and night, spread through the opening of buildings constructed of ALC, causing internal fire. There is an incident of fire spreading through the opening.

However, in the midst of raging fire, there was some buildings that escaped total destruction. The ALC proved its effectiveness in preventing the fire from spreading further afield.

ALC Panel's fire - proof property

ALC won the certification as a fire - proof material following the test conducted by the ministry of Construction on the following area of performance and was designated as such by the Minister of Construction.

Roof Panel	Thickness = Thickness in excess of 75mm fire retardation for 30 min.
Floor panel	Thickness = Over 100mm for 1 hour Thickness = Over 128mm for 2 hours
Wall panel	Partition = Thickness over 75mm for 2 hrs. Exterior wall = Thickness over 100mm for 2 hours

30 minutes fire retardation: it means the material has fire-retardation property. It can resist fire in an ordinary circumstances. It has fire-resistance property that enable it to resist fire for 30 minutes.

It is the material that does not melt, deform or otherwise contribute to spreading of fire in the disaster situation, and that does not emit smoke or gas that may increase the danger of fire. It proved to have high-fire resistance property among the fire-proofing material, by passing the most rigorous fire-proof tests conducted by the fire-proof testing lab.

Fire - proof structures

Fire-proof structure is one that will not easily set aflame by neighboring fire, and one that confines any internal fire that do occur within the fire zone in the building.

It is also the structure that does not crumble even in the fire that gutted the whole building due to its fire-resistance a property and suffer little decrease in structure strength in case of fire.



Surrounding area completely gutted. Note that a wooden house between 3 and 4 is burned down ALC Bldg. 1 & 2 are standing intact.



Building 3 ALC Structure is still standing even with gutted interior. ALC 1 & 2 are intact.



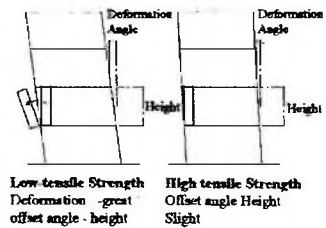
2 ALC Building with gutted interior. ALC Bldg. 1 partially burned is still standing

1. High tensile building enhance quake-resistance property.

ALC is a construction method in which the panels, attached to the steel frame structure, constitute structure body. Since, the precision with which the steel frame is assembled and the strength of building greatly influence the integrity of the structure, a co-operation between those engaged in this (Designer, contractor) is essential.

1) Low tensile Strength building

Structure frame (Beam) with low tensile could cause damages to exterior material and consequent fallout.



Degree of deformation as a function of lateral displacement of an individual storey produced by an earthquake, in relation to center of gravity, is called deformation angle: higher the tensile strength, smaller the deform angle.

2) If the material used in the structure body is of correct size,

or if the height of building is excessive, the resulting stress imposed on the structure by the unequal balance, will damage the exterior building material. Higher the building height, greater the degree of imbalance.

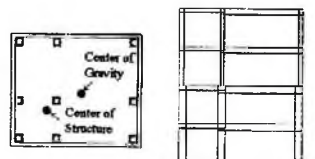


Certain storey with tensile strength

3) Building with unequal load

distribution that places undue stress upon certain part of structure as a result of incorrectly placed walls or beams on the horizontal plane is susceptible to damages.

Support column with bad vertical balance also lessens the tensile strength of that specific floor.

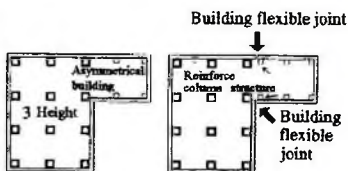


Badly balanced wall on horizontal plane

Badly balanced vertical beam with weak tensile strength

4) A symmetrical building

In a building, which is asymmetrically shaped on both lateral and horizontal plane, adjoining parts of the building is susceptible to damages, to counter variable forces acting on it,



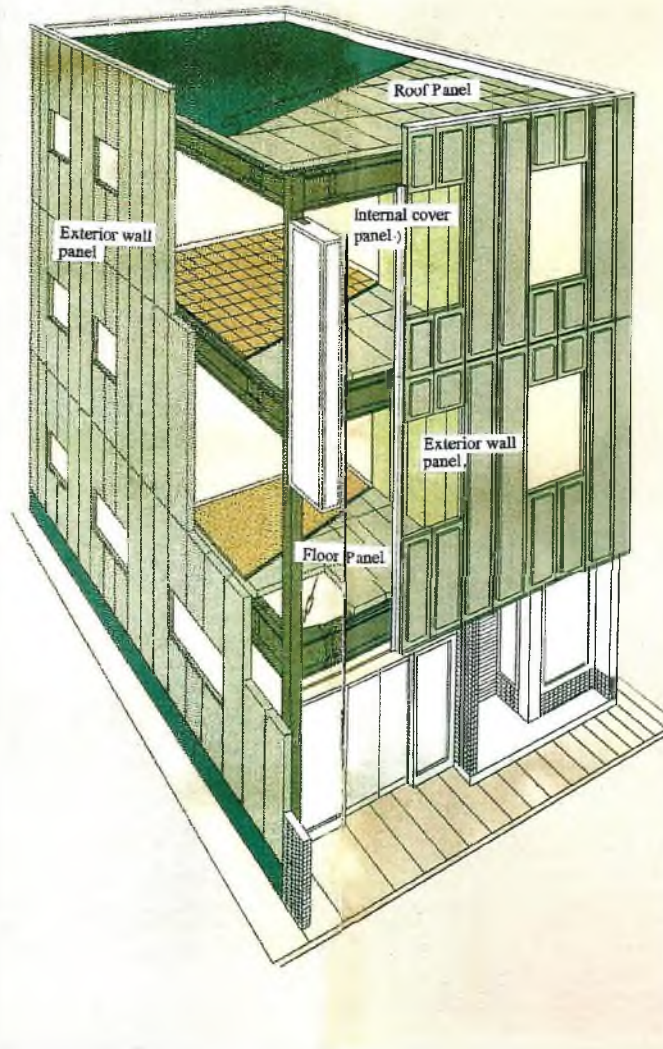
A symmetrical building

Isolating the foundation and incorporative flexible joint to counter variable forces.

structure, including the foundation should be isolated from shock by incorporating flexible joints.

ALC Building

Roof, floor, exterior panel, 3 storey residence cum shopping center.



2. ALC

The attachment method of ALC is based on a long period of field experiences. It is technically mature and proven method. A careful study is required for selecting a proper method for a specific scale and function of the building.

ALC is light in weight, and because of fire-resistance and insulating properties, its unique properties can be utilized only if the following conditions are met;

1) Proper selection of Panel

ALC is high quality factory manufactured panel, produced essentially on order basis. Reinforcement steel rods are strategically placed in load bearing point throughout the internal structure of the panel in varying quantities.

There are wide selections of panel of various kinds and functions. This factor should be well understood when selecting the right panel for a specific purpose.

2) Product specification and size

ALC panel comes in a 600 mm standard size.

3) It is possible to realize

cost effective construction program by adopting a plan incorporating the standard specification ALC panel into building design, thereby simplifying the work and reduce the time required for the project.

4) Due consideration for the project

Attaching ALC panel, modification, and finishing works should be performed only by an experienced

construction technician. Cutting and modifying the panel on the site reduce job efficiencies and may affect the structure strength of panel. To avoid such problem, a well thought out design is essential.

5) Correct finishing job

ALC panel surface need protective finish coating, to protect it against water seepage and scratches and surface erosion that blight the beautiful appearance, increased running cost as a result of functional degrading of panel. Consult ALC for correct selection of protective coatings for the finishes suitable for your needs.

6) To retain its superior quality,

and to maintain the durability, ALC requires a good maintenance practices. Due care should be taken when changes that might affect its performance occur, such as changes in the usage of building, changes in the surrounding environment. Proper steps should be taken to counter any adverse conditions that might affect the ALC panel's properties. Remember, proper functioning of building depends on the good maintenance practices.

Japanese Institute Standards for Concrete Panels

These standards are established by the Japanese Builders Association for quality and utilization purposes. They are covering material, manufacturing processes and other specifications. The ALC Panels successfully meet all these requirements and specifications, along with the standards given by the Japanese Builders Association with regard to panel construction method.

PERFORMANCE AND REALIABILITY OF ALC

From Sky-craper to resident housing, the superior properties of ALC are highly praised and are adopted and used as exterior wall, roof and floor.



Resident



Resident



Resident



Communist Resident



Public Facilities



Sky-Craper



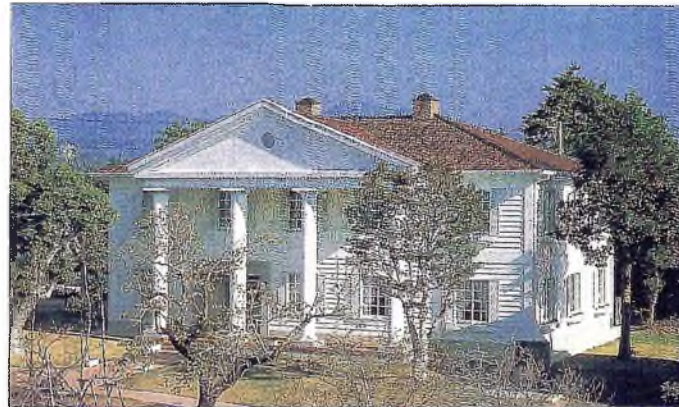
Communal Building



Residential area made of ALC



Hospital



Educational Institution



Communal Housing



Hotel

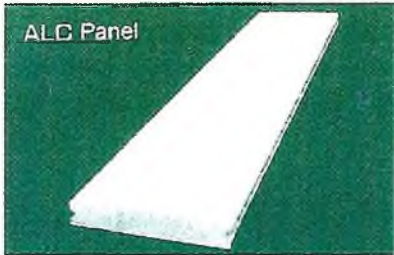


Office Building



Office Building

This is ALC



In your neighborhood, in a busy Down town area, you probably have encountered a scene on a construction site like this:

Building frame structure is being completed as the last steel beam is put into place, white concrete panels are brought in, these panels are then attached to the steel frame, as building takes shape, final touch is applied to the finishing surfaces, almost immediately. People start moving in, inhabiting the place, shops are being opened simultaneously.

This is an ALC construction

To beams and trusses that constitute the structure frame, ALC panels are attached using this methods result. A nice, pleasant looking high performance structure with superior fire-proof, thermal insulating properties that characterize a ALC building.



ALC is produced in the factory under the most rigorous quality control. The asbestos-free, light weight concrete panels are used in such structurally important application as exterior wall, ceiling, floor, and as partitions. They are also used in housing, and in various structures and places where its application won high praise for its unique properties described below.

Superior - fire proof property

ALC, as described in page 7, possesses superior fire-proof property: it has proven its worthiness in fire-prevention and containment of fire that occurred in ALC building in various disaster areas, such as: Kobe earthquake: developed through long field trials, they demonstrated superior quake-proof and fire-proof properties that will contribute to safer building construction.

Securing a pleasant space

ALC possesses ten times the thermal insulating properties of ordinary concrete, they provide a

pleasant living space that is cool in summer and warm in winter. They also reduce energy cost substantially.

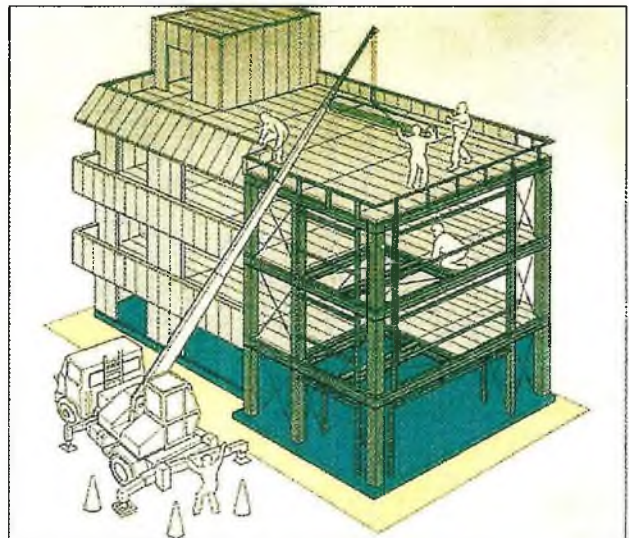
Various surface finishings

ALC, in contrast to other flat panels, comes in myriad shapes and sizes with different surface treatment and patented finishings and patterns: specially designed corner configurations and other modern designs that offer pleasant and appealing surfaces.

Easy and economical application

ALC is quite different product from those produced on the site. The factory manufactured precision panel of light weight (0.5 specific gravity), that is easy and speedy to install, with consequent cost savings.

They are flexible enough to be adopted to any difficult condition, highly praised for their unique properties and as a superior quality material, they are commonly used in the country in the housing, manufacturing factories, and public buildings, in various sectors.



MEMBER OF ASSOCIATION (ALC) - CHEVOLEX



ALC
ALC ASSOCIATION

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