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PLASTIC FRAME INDUSTRY AND DETERMINATION OF IT'S MARKET SHARE IN TÜRKİYE

(MASTER THESIS)

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(YÜKSEK LİSANS TEZİ)

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ÖZET

Günümüzde ülkelerin gelişmişlik derecelerini bir ölçüde onların pazarlarında dolaşan ürünlerin kalitelerine bakarak tahmin edebilmek mümkündür. Çünkü, bu ürünlerin kalitelerini söz konusu ülkenin mevcut teknolojisi, endüstrileşme seviyesi ve sosyo ekonomik koşulları belirler. Piyasada, dolaşım halindeki ürünlerin incelenip ülke pazarına, daha ileri anlamda ülke ekonomi ve endüstrileşmesine ne katıp, ne katamayacağının, hangi yatırım ve imalat şartlarında daha faydalı olacağının belirlenmesi, araştırma geliştirme çalışmalarını başlatarak ilgili teknolojilerinde gelişimini sağlayacaktır.

Plastik doğramalar gelişmiş ülkelerde yaygın bir biçimde kullanılmakta olan, ülkemizde ise özellikle son yıllardaki içindeki hızlı çıkışı ile dikkatleri üzerine toplayan, halk arasında ve inşaat sektöründe sıkça kendinden söz ettiren yeni bir üründür.

Bu çalışmada; özelliklerinin neler olduğu henüz tüketicilerce tam olarak bilinmeyen bu ürünün mevcut yatırım şartları ile 2000'li yıllardaki Türkiye'nin ihtiyaçlarına ne ölçüde cevap verebileceği , avantaj ve dezavantajları ortaya konulmuştur.

Çalışma; mevcut doğrama türlerinin altyapılarının incelenmesi, bunların teknolojik açıdan imalat ve uygulanabilirliğinin degerlendirilmesi, yeni ürünlerin pazara giriş koşullarının incelenmesini içeren modellerin gözden geçirilerek bu sektör için en uygun olanının seçilmesi, piyasadaki belli başlı doğrama imalatçıları ile mülakat yapılarak pazar paylarının ve hedef müşteri kitlelerinin belirlenmesi, seçilen modelin uygulanması, çözülen modelin ışığı altında pazarlama ve fiyatlandırma stratejilerinin belirlenmesi aşamalarından oluşmaktadır.

Tezin I. Bölümünde çalışmanın spesifik hedeflerini ve bunlara hangi adımlar ile ulaşılabileceğini açıklayan bir giriş sunulmaktadır. Bölüm II'de mevcut doğrama malzemelerinin, III. Bölümde ise mevcut pazara giriş modellerinin genel olarak gözden geçirilmesi yer almaktadır. Bölümde IV'de modelin metodolojisi ve uygulanması, V. Bölümde ise model sonuçlarının değerlendirilmesi ile ortaya çıkan öneriler bulunmaktadır.

Çalışmanın en önemli özelliği; gerekli verilerin doğrudan sektörde bulunan kuruluşlardan titizlikle toplanmış olması ve böylece akademik ve profesyonel yaklaşımla kurulan modelin tamamiyle gerçek bir ekonomik hareketi yansıtıyor olmasıdır.

ABSTRACT

Today it is possible to estimate the approximate development level of a country simply by looking at industrial products that are available in her market. Because the qualities of products are best indicators of the existing technology level, degree of industrialization, and social and economical conditions. Research carried out on the products in the markets with the aim of the estimating their possible contributions to both industrialization and economy and in order to determine under which investment and production conditions they will be more profitable, helps the growth of the relevant technologies and initiation of related R&D efforts.

PVC system frames, which are widely used in industrialized countries for the last ten years, has attracted attention in Turkiye as well, with the rapid growth of it's market share within the past five years, and is being labeled as the product tending to it's mature phase.

This study shows, to what extend this new product will satisfy the needs of Türkiye in 2000 within the construction sector, with its advantages and disadvantages.

This study consists of the following steps: Evaluation of existing frame making technologies and their critical review from technological point of view, review of market penetration models and selection of the most appropriate one, collection of necessary data to construct the model by interviewing with the major frame producers and determination their market shares and target customer groups, implementation of the selected model and recommendations about pricing and marketing strategies under the light of model results.

In Chapter I, an introduction is made and the specific objectives of the study and how they are achieved are explained. Various window frame material types and market penetration models for new products are reviewed in chapter II and III, respectively.

Chapter IV is devoted to methodology and application of the study, whereas the last chapter contains the results and recommendations.

Since all the necessary data and information that are obtained through a comprehensive market research and the model reflects a living economic situation under the light of both academic and professional approaches, the results of the study are found to be sound and highly reliable.

CHAPTER I

INTRODUCTION

The significant growth of plastic originated materials in last 30 years, throughout the world offers many alternative products in various fields. PVC profiles are one of these plastic originated products, that can manage to have a market share as a frame material against wood and aluminum.

The result of all research and development efforts dating back to early fifties has made the seventies the golden era of plastic frames throughout the world. First attempts to produce PVC profiles were made at approximately same time in our country as well. After long struggle, this new material has proven itself as a viable frame material. It is worth to mention here that all pioneering work in Turkiye has been carried out by PIMAS, one of leading plastic material producer companies.

The relative position of PVC frames against conventional frame materials of wood and its strong rival aluminum is not clearly known in Turkish market. So the objectives of this study consist the determination of the following for PVC frame materials:

- Technical advantages and disadvantages.
- Economic considerations.
- Possible growth of market penetration.
- Whether the existing production capacity and growth rate will meet the increasing demand and especially in the year 2000 ?

In order to meet these objectives satisfactorily, the following studies must be carried out and assumptions must be made:

- A pilot region (city) which possess the necessary properties like having variable

climatic conditions and having a very rapid growing construction potential, must be selected.

- The construction potential for Turkıye in 2000 must be estimated through forecasting techniques like Seasonal Trend Models by employing the data of previous years.

- The characteristic transparent area ratios for various building types must be determined and total transparent areas must be obtained in order to estimate window frame materials need for 2000.

- Existing capacities of PVC , Al Alloys and wood frame producers must be determined.

- Possible market potential, and market shares in 2000 of the different frame material must be forecasted.

- An appropriate market penetration model must be chosen and constructed. The results of model, then must be confirmed.

CHAPTER II

A GENERAL REVIEW OF WINDOW FRAME MATERIALS

Plastic frame is not widely known in the Turkish market and some producers or sellers try to overemphasize its desirable features to make more profit.

In order to learn the plastic frame technology thoroughly, without being affected by the advertisements, it's production and fitting technology along with it's thermophysical properties must be compared with those of wood and aluminum based frames.

A. FRAME MATERIAL AND ITS SUPPLY OPTION.

Lumber for wood frame is obtained from our national forest resources or it is imported. Then wood has to be turned into frame profile, either through lumber mills or by professional carpenters. This process is not as easy when the frame material is PVC or Al where the profiles are produced in desired forms by extrusion.

The quality of wood may differ from frame to frame as it is difficult to maintain the quality even in the same lot. But, in PVC or Al frame systems, profiles are drawn from the same or similar mixture every time, in same quality.

Some wood goes to waste during shaping the wood into profile. PVC and Al will have scraps but they can usually be recycled.

Aluminum and plastic frames can be supplied in required size and quantity as they are produced of Al and plastic profiles, respectively. If the order is given to the producer with sufficient time, there will not be any major supply problem. Because the

profiles used for making either type of these frames are produced in large volume by hot extrusion method and the capacity is sufficient, at present.

Procuring the raw material may be a problem. In general, major producers import their Al and PVC needs from abroad. Only a small portion of raw materials are supplied locally; however this capacity is not enough to feed the all the producers and the quality level is questionable.

However, until there has not been a problem in providing raw materials to the market for making either Al or plastic frame.

B. FITTING TO BUILDINGS.

Application to the buildings is different when frame is not made of wood. In Türkiye, most plastic frames are produced without any license or know-how. They are all of local design and were developed after studying and copying the foreign plastic window systems with little or no research. However, at present, many of PVC frame systems produced in Türkiye satisfy the European PVC frame standards although only a few of are produced under foreign license.

In general, PVC frames are produced by small or medium scale technical groups who purchase PVC or Al profiles and then make the frames according to the customer's order. Usually major profile and frame producers belong to same group. If this is the case, then frames are produced by technical group and the customer relations is handled by seller group.

The most important source of technical problems is claimed to be the acquisition of appropriate dimensions for the new buildings and replacements and to produce frames just to fit these measurements.

Adopting the frames to the building must be carried out by experienced and educated person, because every little piece of frame belongs to a system and they are produced to perform a certain function and if they are installed wrongly, the result will be a window that does not function properly.

PVC and Al alloy frames are applied to building with or without blind frame. If there is a blind frame, the main frame of window is installed on the blind, if not, main frame is installed directly on plaster of the wall. If the plaster is not smooth enough, then these rough spots cause problems. To overcome the defect on the wall, either the wall must be replastered or the system can be installed on a frame of box profile. In that case, the box profile must be buried into the plaster until the surfaces of the box profile and the plaster are at same level.

In replacements, existing old wood frames can be used as blind frames and the new frames can be made of PVC.

C. DEPRECIATION PROBLEMS.

If the frame material is wood, frames are attached to unwalled empty slots of a building after the rough walling is completed. Then plastering and painting are finished. Wooden frame can most likely be damaged or destroyed at and after this stage and other problems such as fading, rotting, rusting, absorbing water and deformation may result [1].

To prevent these problems, the frame must be painted and protected against parasites, insects, etc.

When selected material is PVC or Al alloy, then the above mentioned problems

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[1] *Denotes the access number in reference list*

will disappear and also some superior qualities will appear. To start with, these profiles don't need to be painted and they do not require maintenance. But the color of some PVC frames may fade by time.

There are two main methods to make colored PVC profiles:

a. Some special dye materials are included to molten PVC mixture from which the profiles are extruded. Desired color can be obtained, but the life of the color may vary from 1 to 5 years. To overcome possible coloring problems, producers advice when fading occurs, frames must be painted after an emery process applied.

b. Profiles are covered with colored and designed PVC folios, this is called lamination , in this method fading will not be problem.

Anodizing is the process that is used to color the Al profiles. This is a ticking process of the natural oxide film that is formed on the surface of aluminum and protects the underlying metal against to corrosion.

The oxide film can be colored or uncolored depending on requirements. Colors may vary from silver to silver bronze.

Yellow color is obtained with a special dye solution though silver color is obtained with anodic coating that is produced electrolytically by cobalt based process [2].

D. RESPOND TO VARIABLE AMBIENT CONDITIONS.

Wood contains some water in its body. The reference point for moisture content for oven-dried wood is approximately 10 %. When it is exposed to air it may absorb or lose moisture depending on the relative humidity of air and existing moisture status of wood so its density and some of it's properties change. When it loses its water, it shrinks and its modulus and strength increase as the cellulose fibres pack more closely.

To prevent changes in dimensions and possible distortion, wood should be dried to the level which is in equilibrium with the humidity where it will be used. If the wood is selected as frame material all possible variations which occur in strength and elasticity and volume depending on water absorption must be considered.

In addition; wood is an anisotropic material. That's why the thermodynamic properties along the grain are different from those values based on across the grain. Anisotropy of wood increases as the density decreases. For example Oak and Balsa are less anisotropic than the other known wood types [3]. In structural applications, wood is usually loaded along the grain so only the axial modulus is important. If it is occasionally loaded across the grain it is important to know the stiffness which can be a factor of 10 or more smaller than when it is loaded along the grain [3].

PVC is a thermoplastic material, its mechanical and physical properties are largely determined by intermolecular forces. Because the secondary bonds that bind the molecules to each other are weakened at elevated temperatures, they can soften and they can become harder and stronger when cooled. Softening and hardening processes can be repeated as often as desired and no chemical change is observed. Their strength is stable between -60 and +80 ^{o}C degrees and also PVC profiles are not effected by ultraviolet rays, some chemicals like benzine, alcohol, detergent, etc. as they contain some preventive additives in the formula.

They do not burn, when the flame source is moved away, the chlorine gas which comes off from the PVC this will put the fire out.

Galvanized iron sheets that are installed into PVC profiles enhance the strength of PVC frames against the wind and rain. Produced PVC profiles yields good results in the strength tests that are done under the heavy rain and the wind with speeds up to 120 km/h.

When frame material is one of Al alloys and frame is an actually system supported with know-how or license most problems are easily overcome. Al alloys in general do not have quite the superior corrosion resistance of pure Al so anodizing is not only a process to color the Al profiles, but also a process used to protect the metal against corrosion. It's melting point is around 616 ^{o}C. Al alloy's strength rapidly decays as temperature increases so they shouldn't be used where operation temperature is above 260 ^{o}C.

Extruded Al profiles are used jointly with fiber glass reinforced polyamide profiles. This heat insulating profiles are designed not only to bear the load of the frame but also to eliminate the forces that are rain and wind originated.

Caulking is one of the oldest insulating material that is used between glass and wind. It must be selected by considering the kind of wood and climate. They generally dry and crack after two or three summers; thus allowing and causing water leakage and air infiltration. In PVC or Al alloys system frames, a material that is called Ethylene Propene Diem Rubber (E.P.D.M) is also used which has significant elasticity between -30 and +90 ^{o}C degrees. In the market, it is mentioned that it has an infinite economic life [4].

Some properties of raw wood , PVC and Al alloys are given in Tables 1,2 for comparison purposes [3,5,6].

Table 1: Physical Properties of Al-6063 And PVC.

	DENSITY Mgm^{-3}	TENSILE STRENGTH MPa	YIELDS STRENGTH MPa	MELT/SOFT TEMPER. K°	YOUNG MODULUS GPa	FRACTURE THOUGHNESS $MPa^{-1/2}$	THERMAL CONDUCTIVITY $Wm^{-1}K^{-1}$	THERMAL EXPANSION COEFFICIENT MK^{-1}
AL-6063	2.7	241	214	890 (Tm)	71	20-70	140	24
PVC *	1.4	40-60	-	370 (Ts)	2.4-3	2.4	0.15	50-70

* Polivinly chloride

Table 2: Physical Properties of Wood.

WOOD	DENSITY Mgm^{-3}	HARDNESS (R) N	YOUNG'S MODULUS (L) MPa	STR. TENSION (R) MPa	STR. COMPRES. (L) MPa	STR. COMPRES. (R) MPa	STR. MODULUS OF RUPTURE MPa	THERMAL CONDUCTIVITY $Wm^{-1}K^{-1}$
WOOD (AVERAGE PROP.)	0.50	3380	11020	3.17	43.60	4.94	82.60	0.14
WHITE OAK	0.68	6000	12300	5.4	51	7.4	105	0.166
PAPER BIRCH	0.55	4000	11000	--	39	4.1	85	--
DOUGLAS FIR.	0.50	2900	12500	2.4	51	5.2	87	--
WHITE PINE	0.38	1900	10100	---	35	3.2	67	0.112
RED WOOD (OLD)	0.40	2100	9200	1.7	42	4.8	69	--

R: Radial
L: Long
STR: Strength
COMPRES: Compression
PROP: Properties
* Wood shows ordinary thermal expansion, its magnitude is small compared to dimensional changes caused by drying (α= 5 MK^{-1} along grain, 50 MK^{-1} across the grain)[5,p:598].

E. INSULATION AND SYSTEM FRAME PERFORMANCE TESTS.

Norms are generally created for two basic reasons. First, related sector wants to define the high quality and significant performance levels in order to employ an autocontrol mechanism to ensure that the current production will satisfy the desirable levels of that statandards. Second, the government or the public authority wants to provide at least a minimum performance level by regulations in order to protect the public's interest and their confidence. Meanwhile, the responsible companies in the sector will also have an opportunity to defend their high prices caused by high quality and performance levels against the substitutable products that offer poor quality levels.

Most widely used window performance tests with respect to DIN norms are given in Table 3.

Table 3: International Standards Of DIN Norms for Window Performance Tests

DIN NO:	TEST CODE	TEST NAME
18055	EN 42 EN 86 EN 77	Air Infiltration Water Infiltration Wind Strength
52210,2719	---	Noise Insulation
4108,1748	---	Heat Insulation
---	---	Sliding Force
---	---	Brandish Force

The last four types of tests in Table 3 are used from time to time and recently the last two are being respected more frequently.

Both of the frame systems made of PVC and Al based alloys give similar infiltration coefficients. While the related coefficient is claimed to be around zero for PVC systems, it is taken as 0.1 m^3/hm for Al based frame systems.

However for both materials the insulation values against humidity, water, air and dust correspond only C level of insulation which is the minimum acceptable performance level according to DIN norms.

Noise insulation coefficients for PVC and Al based frame systems are found to be in the intervals of 35-29 and 40-44 dB respectively. They are in the limits of necessary noise insulation levels according to DIN norms.

Another vital subject that should not be overlooked is the thermal conductivity value of a frame material which will be different from the system frame's overall heat transfer coefficient. Because the concept of system frame means an integrated structure that consists of various types of material all with different thermal conductivity coefficients; depending on the system design the new system frame will acquire a higher thermal resistance, hence lower thermal conductivity values.

Most booklets and other presentation catalogs give thermal conductivity values of Al,Wood and PVC in question (Table 4). The fact that metals have higher thermal conductivities with respect to PVC that is easily seen from this table.

However, the fact that the overall heat transfer coefficient obtained by Al system frames is lower than the PVC systems that is never declared in such leaflets.

To make a healthy comparison, thermal conductivity coefficients of frame materials and overall heat transfer coefficients of system frames are given in Tables 4 and 5 [3,5].

Table 4: Thermal Conductivity Coefficients of Frame Materials :

	$Wm^{-1}K^{-1}$
Wood	0.14
Al Alloys(6063)	130-150
PVC	0.15

Table 5: Overall Heat Transfer Coefficients of Window Frame System (See Appendix-D&E):

	$Kcal/m^2K$
Al Based Frame System (Four Double Glass)	1.978
PVC Based Frame System (Four Double Glass)	2.6
* Al Based System Frame Profile	1.7-1.81

It is clear the overall heat transfer coefficient of Al system frames is 1.978 is the lowest of all: hence the heat loss or gain will be minimum with this types of frames.

In addition, nearly all the steps of locally made Al system frames production process have to satisfy related limits of DIN norms as they are produced under license. For PVC system the process is not as clearly identified as the Al system. At least, some of the galvanized profiles that are installed in PVC profiles to strengthen it, against loads may rust by the time.

When all factors are considered, it can be concluded that Al system frames properties are significantly better those of PVC frames.

The physical and thermophysical data as it appears in the catalogs provided by the respective producers and manufacturers can be found in Appendices D and E.

CHAPTER III

A GENERAL REVIEW OF MARKET PENETRATION MODELS

Examining the diffusion process and estimating the market share of new products or technologies are of great importance for firms developing new products, planners, and researchers. Diffusion of new technologies depends on many factors such as government regulations, investment costs and related expectations, finance possibilities, usefulness, compatibility with living standards and cultural habits, safety and reliability. Input to some decision problems related to selecting the technologies on which R&D activities should be concentrated; and accelerating the diffusion process of technologies which are proven to be technically and economically feasible, is obtained by using market potential and market penetration models.

Market potential is defined as the upper limit of the market share of a new product or technology, which can be achieved in long run. Models to estimate the market potential use approaches based on preferences of decision makers among different alternatives. Market penetration models aim to determine how the adoption process of a new product or technology is affected by the properties of the new product or the technology and by various other factors. Two different approaches are available for this purpose. One approach constitutes the time oriented models which forecasts the growth of the market attained by the new product or technology over time. In those models the characteristics of the product are considered only implicitly. [7,8,9,10,11]. The other approach constitutes the value oriented models which estimate the size of the market that would be attained by a specified fixed time. In contrast to time oriented models, this models consider the characteristics of the products explicitly. [12,13,14,15,16]. In those

models perceptions of the individuals who will use that technology in the future gain importance.

In the literature, many approaches for modeling technological diffusion processes are available. Most widely used ones of those approaches are the S-curve models. The characteristic shape of this curve was first used by the sociologist Tarde [17] who proposed that new ideas are accepted in such a fashion.

A. TIME ORIENTED MODELS

Time oriented models forecast the growth of the market attained by the new product or technology over time. The general equation for those models can be given as follows [8,9]:

$$\frac{dF(t)}{dt} = g(t)\,[\bar{F}(t) - F(t)] \qquad (1)$$

$$F(t=t_o)=F_o$$

where,

F(t) = Cumulative number of adopters at time t or the percent of the market share achieved by time t.

$\bar{F}(t)$ = Market potential ($\bar{F}(t)=F$, for static models)

g(t) = Product growth coefficient at time t or the propensity to adopt.

Letting

$$g(t) = a + b\,F(t) \qquad (2)$$

we obtain,

$$\frac{dF(t)}{dt} = [a + bF(t)]\,[\bar{F} - F(t)] \qquad (3)$$

or

$$\frac{dF(t)}{dt} = a\,[\bar{F} - F(t)] + bF(t)\,[\bar{F} - F(t)] \qquad (4)$$

$$F(t=t_o) = F_o$$

where a and b are constants which can be defined as the coefficient of innovation and coefficient of imitation respectively. Thus, the term a[F-F(t)] reflects the adoption by innovators and the term bF(t)[F-F(t)] reflects the interactions between adopters and non-adopters of an innovation. Solving the differential equation given above one obtains ,

$$F(t) = \frac{F - \dfrac{a\,(\bar{F} - F_o)}{a + bF_o}\, e^{[-(a+b\bar{F})(t-to)]}}{1 + \dfrac{b\,(\bar{F} - F_o)}{a + bF_o}\, e^{[-(a+b\bar{F})(t-to)]}} \qquad (5)$$

For different values of a and b , various types of time oriented models can be obtained.

1. <u>Exponential Models.</u>

Taking b equal to zero and F(t=to)=0, the following exponential model given by

Fourt and Woodlock [18] is obtained:

$$F(t) = F[1 - e^{(-at)}]$$

In exponential models, the coefficient of innovation can also be defined as the probability of finding an individual who adopts the product in a small time interval is proportional to the remaining number of individuals who have not yet adopted, the length of the time interval, and the average propensity individual per unit time.

The most important characteristic of those models is that all adopters are viewed as innovators. Thus, exponential models are applicable in cases where the perceived risks are quite low. (Fig.1)

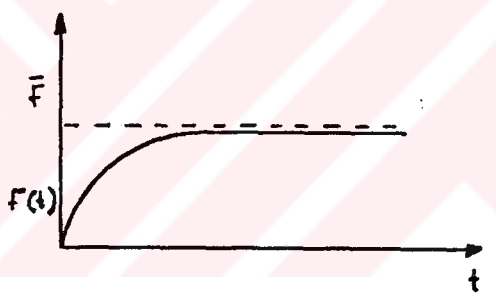

Fig 1. An Example of Exponential Models

2. Logistic Models.

In contrast to exponential models, in logistic models the coefficient of innovation is taken as zero, and

$$g(t) = b\,F(t)$$

The logistic model given by Hudson [19] and which can be obtained from the general model by applying these conditions, is as follows:

$$F(t) = \frac{\bar{F}}{1 - \left(\frac{\bar{F} - Fo}{F}\right) e^{-b\bar{F}t}}$$

Logistic or S-curve models are commonly used to model the adoption process of a new product. The shape of curve reflects the initial inertia in the penetration process as the market slowly overcomes the uncertainties and the perception of risks.

There are many logistic models in the literature, using different generalizations, and most of those models try to incorporate the flexibility to interpret the available data in the best way without losing the characteristic S-shape of the curve.

Both the exponential and the logistic models assume only aggregated effects on the adoption rate due to previous adoption. In exponential models, it is assumed that the effect is due to the decrease in the number of individuals still available to adopt the product. In logistic models, an aggregated experience factor which reflects the risk averse behavior is used. When only a few people have adopted, the probability to find an individual willing to adopt is quite small, but as the number of adopters increases, that probability also increases. As a result the adoption process which has started slowly accelerates after a point and again slows down as the market reaches its saturation point.

3. Linear Learning Models.

Both in the exponential and the logistic models, any change in the adoption probability with time is not considered. However, learning by education and advertisement can change the opinions off the individuals about innovations. For this purpose learning models are developed, the simplest and most common one being the single event linear learning model. [20]

Variation of product growth coefficient by the time

$$g(t+1) = c\, g(t) + d \quad 0 < c < 1 \,,\, d > 0 \qquad (6)$$

is accepted.

When $t \to \infty$

$$g(t) \to d / 1 - c$$

(6) can be written as follows:

$$g(t+1) = c.g(t) + (1 - c).g_{\infty} \qquad (7)$$

g_{∞} is the equilibrium value of g(t) in long range. When it is solved

$$g(t) = c^{t} g_{o} + (1 - c)\, g_{\infty} \qquad (8)$$

$$g^{o} = g\,(o)$$

is obtained. According to the phenomenon of accepting by time it is supposed that g_o is less then g_{∞}.

When a= g(t) and F=1

$$F(t) = 1 - e\,\{-[\, g_{\infty}\, t - \frac{(1 - c^{t})\,(g_{\infty} - go)}{\ln (1/c)}\,]\,\} \qquad (9)$$

is obtained. While $t \to \infty$, $c^{t} \to 0$ therefore F(t) becomes an exponential function and as

$g_o < g_\infty$ F(t) will be an S curve.

4. Overview Of The Other Models.

There are several other models in literature which are special cases of the basic models mentioned above. One such model is the Weibull Model [10]. In this approach, it is necessary to define the two models respectively; New Product Growth Model developed by Bass and Weibull Model that is suggested depending on Weibull distribution function in scope of time oriented models.

a) New Product Growth Model: This is a model that is developed to estimate the initial market penetration of the new products. The most important property of the model is that the propensity of innovation and imitation are reflected together. So properties of model can be thought as a mixture of logistic and exponential models. The other feature of model is that, b which is the coefficient of adoption by imitation is inversely related with F which is the upper limit of market. Therefore b; the adoption rate will be slower in a big market than in a small one.

Related assumptions are as follows;

i. $b=q/\bar{F}$ $(q = 0)$

ii. $F(t=0)=0$

iii. $a = 0$

When the assumptions given above are applied in the equation (5) , Bass Model is obtained.

$$F(T) = \frac{\bar{F}[\,1- e^{-(a+q)t}]}{1+a/q.e^{-(a+q)t}} \qquad (10)$$

b) Weibull Model: This model yields effective estimations for different cases.

Weibull distribution and density functions are as follows;

$$f(t)=(\beta/\alpha).(t/\alpha)^{\beta-1}.e^{-(t/\alpha)\beta} \quad , \quad t>0 \qquad (11)$$

$$F(t)= 1 - e^{-(t/\alpha)\beta} \qquad (12)$$

α and ß are known as scale and shape parameters. Values of the parameters may be considered as the speed of technological change in a certain given time span and the attained portion of the upper limit, respectively. The following model is suggested depending Weibull distribution function.

$$F(t)= \overline{F}[1 - e^{-(t/\alpha)\beta}] \qquad (13)$$

Upper limit , F may be less , greater or equal to 1. If technologic substitution is mentioned, suggested function can be transferred to given form:

$$\ln [\ln \overline{F} / \overline{F}-F(T)] = \beta \ln\alpha + \beta \ln t \qquad (14)$$

$$Y = A + Bx$$

$$A = - \beta \ln \alpha$$

$$B = \beta$$

$$x = \ln t$$

The most important advantage of Weibull Model is that by the methods of least squares, values of A and B are determined, and then, using these values, parameters α and ß can be obtained easily. The critical aspect of the model is the selection of the base year. Since ln 0 is undefined t=0 can not be first year. To determine the first year an algorithm proposed by Sharif and Islam is used. The steps of algorithm are as follows [10]:

Step 1: Choose the base year to be the year preceding the first year for which data is available. Denote the first year for which the data is available as t=1.

Step 2: Fit (14) to the data according to the chosen base year and compute the correlation coefficient.

Step 3: Decrease the base year by one and repeat step 2 with the new base year. If the new correlation coefficient is smaller than the previous one by a desired amount go to step 4. Otherwise repeat Step 3.

Step 4: Select the previous year as the base year for curve fitting.

Steepness of the curves is inversely related both to the value of the market potential and the value of market share of the firms from which the data was collected. A steeper curve implies faster market penetration, and of course as the proportion of yearly sales to market potential increases, higher stages of penetration are implied.

B. VALUE ORIENTED MODELS

In value oriented models the characteristics of the products are considered explicitly. These models are applied for a specified time in future. Penetration of the product to the market is forecasted according to its "value" defined in consideration of probable economic conditions. One important features of those models is the possibility of handling various factors affecting the value of the product and possibility of carrying out parametric analyses. The effects of the assumptions related to governmental regulations, future prices, and inflation on the value of the product can be examined through the use of such model. The most commonly used value variable is the payback period of the initial investment, that is the time which has to pass until the present value of the savings reaches the value of initial investment. For example, the value of solar heating system is determined according to the difference between the annual costs of the fuels it replaces and its annual maintenance and operation cost.

Rather than using a single value criterion, an aggregate value index which takes into account various factors influential on the final decision to adopt the technology,

could be defined. This leads us to decision theoretical models where several economic and non-economic criteria such as the capital investment, operation and maintenance cost, reliability, ease of handling, etc. are used with due consideration of their relative importance. These models are based on concepts of decision theory and require information on value judgements and preferences of the future adopters of the technology.

Logistic and exponential models can be used for value oriented models as well. Exponential models reflect high adoption rates even for low values. But logistic models reflect small adoption rates in small values. Adoption rate is low for the products like solar heaters. It is possible that the value of system increases when the costs of production decrease or costs of their alternatives increase. When value increases enough, production will have proven itself and will be adopted intensely by a large group. Market will be saturated when the value reached is very high. It is possible to see the effect of the value which is in form of definition of production or technology on the market share by value oriented models.

The only problem is, though validation of exponential and logarithmic models are claimed by some empirical findings obtained in time oriented models; value oriented models are still deprived of strong theoretical basis and empirical support to apply S curve or exponential modelling methods.

C. DETERMINATION OF MARKET POTENTIAL

Market potential is an important parameter that has to be estimated for various models, either through some basic assumptions about the market or by utilizing a formal model. The level of the market potential affects the results of the market penetration

models strongly.

In literature, we see many models which take the market potential as unity meaning that the whole market will accept that technology or the product in the long run. Clearly, for many cases, this is quite unrealistic. Models designed for estimating the market potential are based on similar parameters with those used in decision theoretical models; such as the preferences of the future users. Other parameters depend on the technological aspects. It is assumed that people in the market behave in a manner so as to maximize a "figure of merit", which is defined according to the benefits that come from the utilization of technology and in some cases incorporating value judgements and preferences about the possible sources of technology.

Because of the extensive data requirement and time consuming parameter estimations, the models designed to estimate the market potential are not readily applicable for some cases. Consequently, in many applications, heuristic approaches based on the opinions and judgement of the experts are used to estimate the market potential.

CHAPTER IV

METHODOLOGY AND CONSTRUCTION OF MODEL

A. SELECTION OF AN APPROPRIATE MODEL

Research made on market penetration models show that the general trend for market diffusion fits S curves. It has been observed that Weibull Model gives satisfactory results in relating with various market diffusion studies. Because it effectively takes into account the actual data on the initial penetration period and considers the impact of the speed of technological change. Additional benefit of this model is that, the coefficients of imitation and adoption can easily be obtained by using the method of least squares. The results are found to be reliable [10]. Therefore; The Weibull Model has ben chosen for studying the market penetration option of plastic frames in Turkish market.

B. COLLECTING AND GENERATING NECESSARY DATA

1. Data For Determination Of Market Potential

a) Expected Construction Needs Of Turkiye in 2000: In order to estimate the possible construction potential of Turkiye in 2000, total completed construction areas of previous years must be observed. The detected data are shown in Table 6 [21,22]. To be able to forecast the potential for 2000, available data are not enough to apply seasonal forecasting techniques, because data for 12 periods do not exist [21,22]. Therefore; a new forecasting technique which generates nearly the same results with those of Multiplicative Trend Seasonal Methods, is used. Description of the method and it's application is given in Appendix-A.

The result of the model is that the expected construction potential for Türkiye in

the year 2000, is forecasted to be approximately 74,6 x 10^6 m^2.

Table 6:Constructions (According to Construction Permits,Turkiye)

Year	Construction Area(m^2)
1986	55,624,440
1987	70,912,137
1988	67,861,304
1989	62,923,939
1990	60,083,035
1991	61,213,854

b) Possible Frame Needs of Turkiye in 2000: Windows are the best way of letting the day light enter into buildings. Whatever the building is designed for, be it a warehouse,a plant or a house, natural light is needed and desired so that people can benefit from it. The size of transparent areas must be sufficient enough to allow the required light enter into building. Naturally, standards are developed which define recommended transparent area levels or ratios according to utilization purpose of the buildings in question. In this study, the values given in Table 7 which are obtained from relevant standards, are used [23].

In order to estimate the potential frame need of Türkiye for the year 2000, total Transparent Area Ratio (TAR) of that year must be found. Most reliable data on TAR can be obtained for İstanbul. Hence the TAR for this region for 1992 will be calculated and then it will be extrapolated for 2000 and the forecast for the whole country will be made by proper utilization of this extrapolation with due consideration of the share of İstanbul in construction in Turkiye. Because it is easy to see that Istanbul reflects an intensive

growth, and other regions follow but the growth presently is at a slower pace. However considering the countries overall development it is estimated that similar building infrastructure to that of Istanbul will prevail throughout Turkiye by the year 2000.

Multiplication of the recommended ratios in Table 7, with each type of construction areas in Table 8, yields the potential transparent area of Istanbul for 1992.

Table 7: Recommended Transparent Area Sizes According To Building Types

BUILDING TYPES	TRANSPARENT AREA / TOTAL AREA (%)
Residential	15
Commercial	a: Conventional - 50 b: High Rise - 80
Industrial	10
Social, Medical & Cultural Buildings	20
Others	8

Table 8: Constructions (According To Construction Permits, 1992 ISTANBUL)

BUILDING TYPES	CONSTRUCTION AREA (m^2)
Residential	7,784,500
Commercial	1,458,500
Industrial	344,500
Medical, Social & Cultural Buildings	219,200
Others	5,600

But it is necessary to know what percent of total commercial construction area

belong to conventional commercial buildings and high rises. To clarify the uncertainty, calculations are based on the data of İstanbul for 1992. Depending on considered data, generated information shows that 58.6 % of total commercial area is of high rises and 41.4 % is of conventional commercial buildings. After the multiplication process is performed 2,232,067.3 m^2 transparent area which is 22,7 % of total construction potential of Istanbul is found. In order to obtain the same forecast for Turkıye in 2000, same procedure must be followed by employing the construction data of Turkiye which are summarized in Table 9 [21]. Results are the TAR values of Turkiye are found to be around 21.8 % for 1990 and 91 respectively.

Table 9: Constructions (According To Construction Permits.1990-91 TURKIYE)

BUILDING TYPES	CONST.(m^2)1990	CONST.(m^2)1991
Residential	43,918,561	46,159,927
Commercial	8,278,613	8,330,099
Industrial	4,755,727	3,204,773,
Medical, Social & Cultural Buildings	1,489,087	1,751,099
Others	1,641,047	1,767,956

However the growth rate of Istanbul leads the all urban areas in Turkiye recommended transparent area ratios for commercial building will not be as high as of İstanbul for the other cities even in the year 2000. Therefore; 67.6 % average transparent area ratio coming from the percentages of 58.6 and 41.4 which represent the proportions of conventional commercial buildings and high-rises is very high for the country overall. For that reason recommended TAR for commercial buildingswas taken

60 %. After the modification, new TARs are determined as follows: 20.7 and 20.8 % for Türkiye for 1990-91 respectively and 21.6 % for Istanbul for 1992.

Consequently it is assumed that Türkiye, in all regions, will reach today's modified growth rate of Istanbul after eight years and the average percent transparent area ratio of Türkiye is taken as 21.6.

With the determination of TAR it is now possible to forecast the frame needs of Turkiye in the year 2000, because the forecast for total construction is 74,600,000 m^2 and a TAR of 21.6 % gives a total transparent area of 16.113.600 m^2 for Turkiye. In general one m^2 transparent area means six meters of frame material, 16,113,600 m^2 transparent area will require 96,681,600 m of frame which is the forecasted market potential for materials in 2000.

2. Data For Determination of Existing Production Capacity

a) The Results of Interviews With PVC Profile Producers For Windows: In order to determine the existing capacity of PVC frame producers in Turkiye, major producers were found. Then, the information were obtained from these companies through face to face interviews. Two of those companies that were communicated are presently leading the market with their large market shares. Remaining companies are either producers or importers. Based on the information gathered from major producers and some of the importers, annual production capacity of PVC frames is obtained for 1992 and is shown on Table 10.

b) The Result Of Interviews With Al Alloys Profile Producers For Window: Same procedure was followed to determine the existing capacity of Al alloy profile producers. Only two companies were interviewed. These not only lead the market in production but also set the quality standard within the level field. In contrast to PVC

market, there are several Al profile producers. Seven of which can be classified as major producer. Table 12 reflects the production capacity for Al frames in Turkıye for 1992.

The market share distributions of PVC and AL frames is shown in Appendix-C.

Table 10: Annual PVC Frame Production For Turkiye

COMPANY	PRODUCTION (Ton/Year)	MARKET SHARE (%)
PİMAŞ	6000	42.4
EGE YILDIZ	4000	28.2
PLATAN	660	4.7
PLASTEK	500	3.5
AKIN	500	3.5
KALYONPEN	500	3.5
PAKPEN	500	3.5
IMPORTS & OTHERS	1500	10.6
TOTAL	14,160	100

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AKIN	500	3.5
KALYONPEN	500	3.5
PAKPEN	500	3.5
IMPORTS & OTHERS	1500	10.6
TOTAL	14,160	100

Table 11: Annual Al Frame Production For Turkiye

COMPANY	PRODUCTION (Ton/Year)	MARKET SHARE (%)
FENİŞ	4500	16.1
GENÇER	3000	10.7
ÇUHADAROĞLU	3000	10.7
AYKİM	2500	8.9
ALSAN	2500	8.9
ALÇİN	2500	8.9
AKSAN	2500	8.9
SMALL PRODUCERS	7500	26.8
TOTAL	28,000	100

C. MODEL CONSTRUCTION

1. Assumptions

a) **Qualitative And Quantitative Distribution Of Frame Types In Buildings:** After examining the data on new buildings, constructions, and new projects on the demand side and the reference lists and the information collected from producers on the supply side, the first step was to determine which type of frame is used in which type of building. In general, Al System frames are preferred in large and commercial buildings like office and tourism centers. Wood based frame is usually used in residential buildings. However, it is observed that PVC frame system and ordinary Al alloy frames are beginning to be used more frequently in new and modern residences. Previously, Al frames were preferred, in most commercial, social and medical buildings, but recently, PVC frames have gained considerable importance in this group. Especially large customer group of PVC frame consists of people who are replacing their existing wood frames with PVC frames.

The following assumptions were made for major users of various frame materials:

- Al System frames are used in large buildings,
- Ordinary Al frames and PVC system frames are used in residences, small commercial buildings, and in some social/medical establishments.
- Wood frame is used in remaining buildings.
- Use of steel frames and other frame materials are quite limited and will not affect the model results.

Now that the qualitative distribution is known; quantitative distribution can be found. When the percent of TAR's on building types, become available the upper limit of PVC frames' market share will be obtained.

The results for the years of 1990 and 1991 [21] for Türkiye are summarized in

Table 12 where the building types are classified as follows:

Group I: Residential Buildings.

Group II: Commercial, Industrial, Medical & Social Buildings.

Group III: Others.

Table 12: Total Transparent Surfaces & Distribution Of Total Transparent Area Among The Building Groups

Years	1990	1991
Total Transparent Surface Area (m^2)	12,459,626	12,734,182
Group I (%)	53	54.4
Group II (%)	46	44.5
Group III (%)	1	1.1

Now average transparent area percents of building groups that are obtained from Table 12 can be integrated with the qualitative preferences of frame types as shown in Table 13.

Table 13: Qualitative and Quantitative Distribution of Frame Types

Building Groups	Average Transparent Area Shares (%)	Frame Combination
Group I.	54	PVC+Al+Wood
Group II.	45	PVC+Al
Group III.	1	Wood

b) **Determining Market Potential:** There is no doubt that it is difficult to estimate

the actual PVC frame market potential in Türkiye,for the year 2000. Depending on such factors like availability, alternative frame materials, government policies it may deviate from the forecasts.

However, consumption of frame material for retrofitting and illegally imported PVC must also be considered definitely to improve the reliability of the model results; as their share is not to small to be ignored and therefore they may affect the market potential directly.

In order to reduce the uncertainty associated with the estimation of market potential, the model should be applied for different values of PVC market potential that reflect different market share values for various frame materials. In order to strengthen this approach in this study three different market potential scenarios have been considered.

Scenario I:

In this scenario the subject of retrofit and illegally imported PVC profile is not taken into account. It can be seen From Table 13 is that the distribution of frame type of frame in building groups I and II is not known exactly. So It is basically assumed that 2/3 of new residential building will be fitted with wood frames and PVC and Al frames will have equal shares in the market in 2000. Under the light of this assumptions Scenario I is described in Table 14. According to Table 14 it is seen that in 2000, market will be distributed among the frames materials with the following shares:

37 % Wood frame

31,5 % Al frame

31,5 % PVC frame

When this is indeed the distribution, then total PVC frame need will be 30,261,341

Table 14: Assumptions and Estimated Market Shares of Scenario I for 2000

Disribution Of Total Transparent Area According To Building Groups & Frame Types										
Groups	Total	Transparent Area	Wood		PVC+ Al		PVC		Al	
	%	m^2	TTA. Share	m^2	TTA. Share	m^2	TTA. Share	m^2	TTA. Share	m^2
Group I	54	8,701,344	2/3	5,800,896	1/3	2,900,448	1/6	1,450,224	1/6	1,450,224
Group II	45	7,241,120			1/1	7,251,120	1/2	3,625,560	1/2	3,625,560
Group III	1	161,136	1/1	161,136						
Market Shares	100	16,113,600	37 %	5,962,032 / 16,113,600	63 %	10,151,568 / 16,113,600	31.5 %	5,075,784 / 16,113,600	31.5 %	5,075,784 / 16,113,600

TTA.: Total Transparent Area

m and this need means a capacity of 38,068 tons of PVC[1].

Scenario II:

In order to estimate the PVC volume consumed for replacement, taking as the base, the economic life of wood frame may be reasonable. For the time period between 1991-2000 average transparent area ratio for Turkiye and the average wood frame consumption percent are estimated to be 21.2 % and 50 % respectively. In addition, annual construction volume is also obtained to be 67,188,000 m^2. If it is accepted that the average economic life of wood frame is approximately 20 years, wood frames will require to be retrofitted once in twenty years. Thus; average retrofitting need will be 356,000 m^2 for every year. This demand may be satisfied with wood, Al or PVC frame. In this scenario 2/3 of this demand will be met with only PVC frame is accepted. That means 237,400 m^2 transparent area. This extra retrofitting consumption which mainly caused by wood frame is found to be around 7,122,000 m^2 that requires an additional capacity of 1,780.5 tons of PVC. Scenario II which is obtained by employing the data about retrofitting onto Scenario I is described in Table 15. Though firstly it seems that total transparent surface area will increase the market thoroughly, the extra need will only be met by PVC frame so this will only increase the share of PVC frames in the market. After the market shares are modified, rounded market share distribution are obtained as follows: 36, 33 and 31 % for wood, PVC and AL frames respectively.

Thus 33 % of 16,351,000 m^2 will require 40,469 tons of PVC that is the forecast of PVC market potential for the year 2000.

As a result of the interviews, one m of PVC or Al frame is taken to be approximately 1.25 kg.

Table 15: Assumptions and Estimated Market Shares of Scenario II for 2000

Disribution Of Total Transparent Area According To Building Groups & Frame Types										
Groups	Total %	Transparent Area m^2	Wood TTA. Share	Wood m^2	PVC+ Al TTA. Share	PVC+ Al m^2	PVC TTA. Share	PVC m^2	Al TTA. Share	Al m^2
Group I	54	8,829,540	2/3	5,886,360	1/3	2,943,180	1/6	1,471,590	1/6	1,471,590
Group II	45	7,357,950			1/1	7,357,950	1/2	3,678,978	1/2	3,678,978
Group III	1	163,510	1/1	163,510						
Market Shares	100	16,351,000*	37 %	6,049,870 / 16,351,000	63 %	10,301,130 / 16,351,000	31.5 %	5,150,568 / 16,351,000	31.5 %	
Modified Market Shares	100	16,351,000	35.55 %		64.45 %		32.95 %		31.5 %	5,075,784 / 16,113,600

TTA.: Total Transparent Area

16,351,000* = 16,113,600 + 237,400

Scenario III:

Another vital subject that must be considered is the consumption of illegally imported PVC profiles. Those frame profiles which have defects and which do not comply with the international performance standards and therefore that can not be marketed in the country of origin are being brought to Turkiye which represents a serious quality issue. What is of interest is that these illegal imports seriously affect the sector and projections that consider this source and also the retrofits are perhaps more realistic.

The smuggled PVC volume is claimed to be approximately two times of legally imported profiles. It means an extra capacity of 3000 tons for 1992 and an average capacity of 5000 tons of PVC for each year until 2000 can be estimated. That corresponds 667.000 m^2 transparent area which will be fitted with PVC frames. In this scenario, extra transparent area caused by retrofits and smuggled PVC will only increase the market share of PVC therefore all the market shares are modified in Table 16 where Scenario III is summarized in order to obtain the new market share distribution of this scenario. According to scenario III market share distribution will be as follows:

31.7 % Wood frame

36.8 % PVC frame

31.5 % Al frame

Market share of 36.8 % will mean 6,262,514 m^2 profile that corresponds 46,969 tons of PVC market potential for the year 2000.

Table 16: Assumptions and Estimated Market Shares of Scenario III for 2000

Disribution Of Total Transparent Area According To Building Groups & Frame Types										
Groups	Total	Transparent Area	Wood		PVC+ Al		PVC		Al	
	%	m^2	TTA. Share	m^2	TTA. Share	m^2	TTA. Share	m^2	TTA. Share	m^2
Group I	54	9,189,558	2/3	6,126,372	1/3	3,063,186	1/6	1,531,593	1/6	1,531,593
Group II	45	7,657,965			1/1	7,657,965	1/2	3,828,983	1/2	3,828,983
Group III	1	170,177	1/1	170,177						
Market Shares	100	17,017,700*	37 %	6,296,549 / 17,017,700	63 %	10,721,151 / 17,017,700	31.5 %	5,360,576 / 17,017,700	31.5 %	5,360,576 / 17,017,700
Modified Market Shares	100	17,017,700	31.7 %		68.3 %		36.8 %		31.5 %	

TTA.: Total Transparent Area

17,017,700* = 16,113,600 + 237,400 + 666,700

2. Application of The Model For Scenarios.

Weibull model which is defined to be $F(t)=F\ [1 - e^{-(t/\alpha)^{\beta}}]$ will be applied for each of scenario. Market potentials of three scenario are available. In order to obtain the model parameters α and β, data of recent years are needed. Collected data summarized in Table 17 were put in order to use them in least square method. Parameters of A and B that are obtained by least square method are source of α and β.

Table 17 : PVC Frame Production Capacity Data

Years	Capacity (Ton)	Years	Capacity (ton)
1983	45	1988	4706
1984	85	1989	5980
1985	125	1990	8402
1986	165	1991	10,650
1987	3263	2000	14,650

In application, to obtain the pairs of A and B, the best correlation coefficients come out to be the 7^{th} year in three of the scenarios, according to the algorithm which explained in Chapter III to select the base years. Obtained base years, pairs of α and β and saturation points shown in Table 18.

Table 18: Weibull Model Application Results For Scenarios.

Scenarios	Market Potentials (F,ton)	Market Shares (%)	Base Year	Parameters α and β	Saturation Points
I	38,068	31.5	7	16,75 & 8,183	2001
II	40,469	32.95	7	16,899 & 8,165	2001
III	46,969	36.8	7	17.265 & 8.129	2002

3. Growth Diagrams Of PVC Frame In Market.

$AF(t)=F[1-e^{-(t/\alpha)^{\beta}}]$ is general equation of Weibull Model. F=44,353 ton/year is the market potential for PVC frames and 31.3 % market share of PVC. Base year is 7^{th} year, α and β are 17.124 and 8.143 respectively. The penetration curves drown by using the data given in Table 18, according to the general equation of Weibull Model are shown in Fig2, Fig3 and Fig4 respectively.

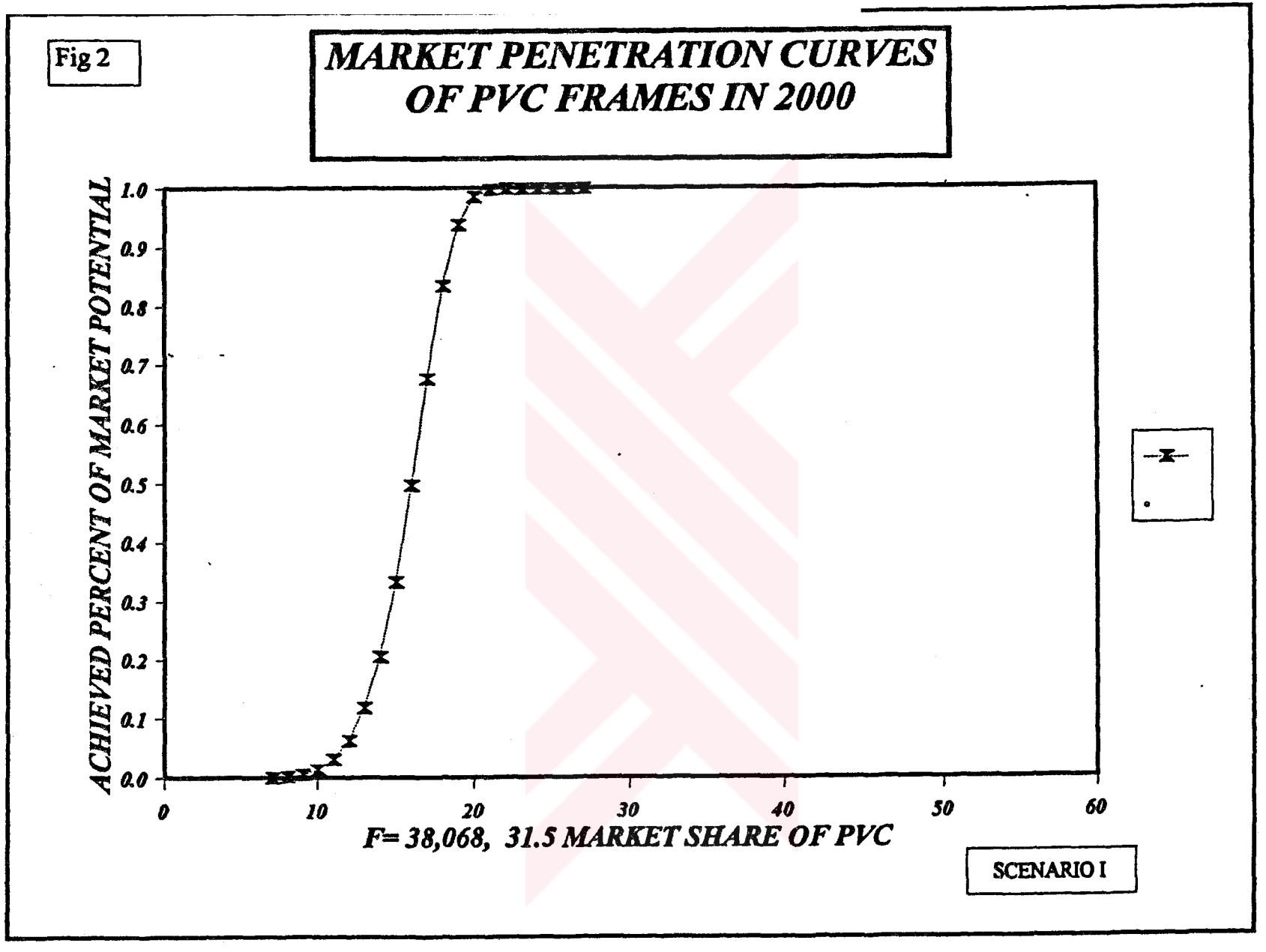

Fig2: Market Penetration Curve for Scenario I

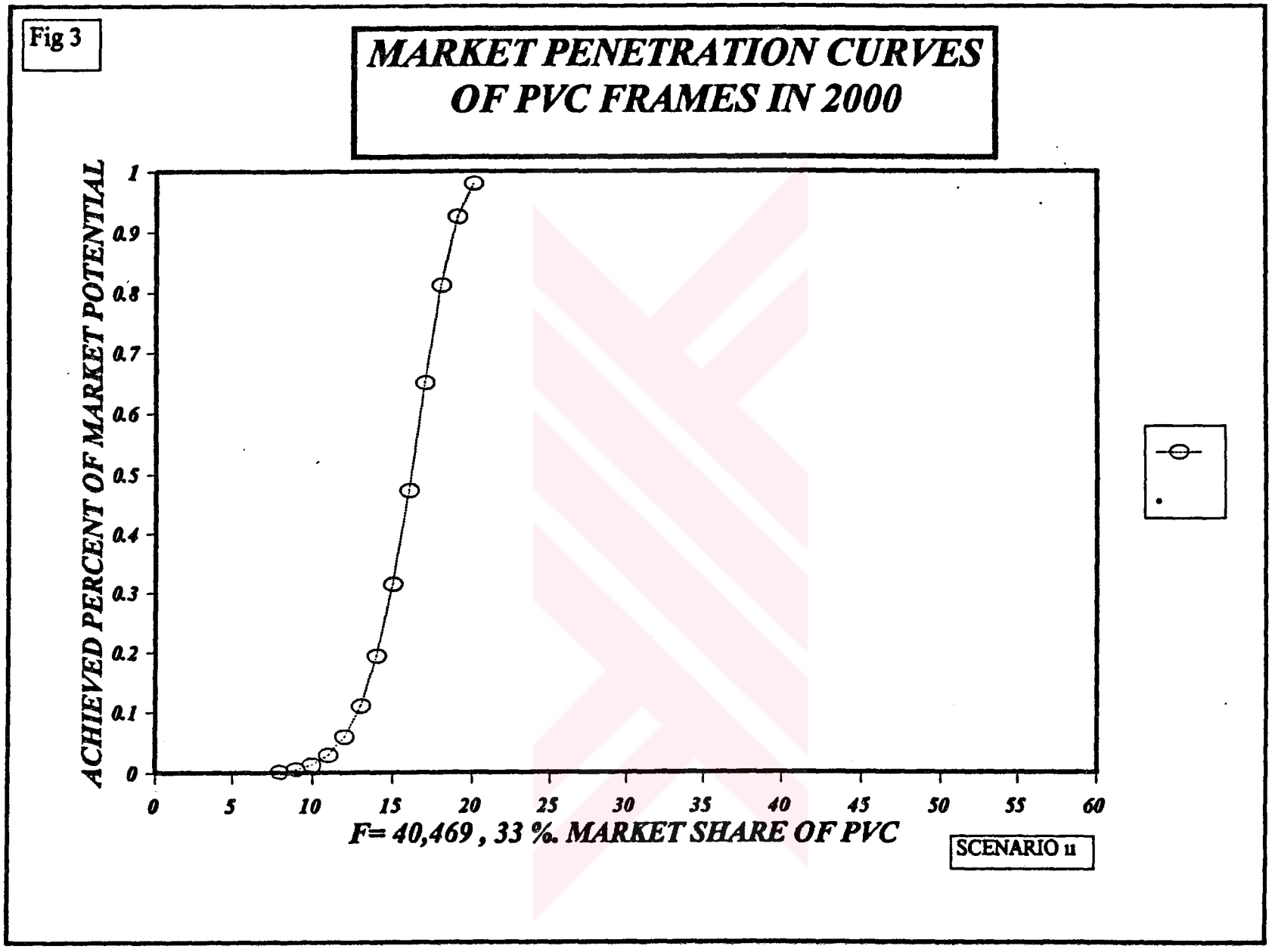

Fig3: Market Penetration Curve for Scenario II.

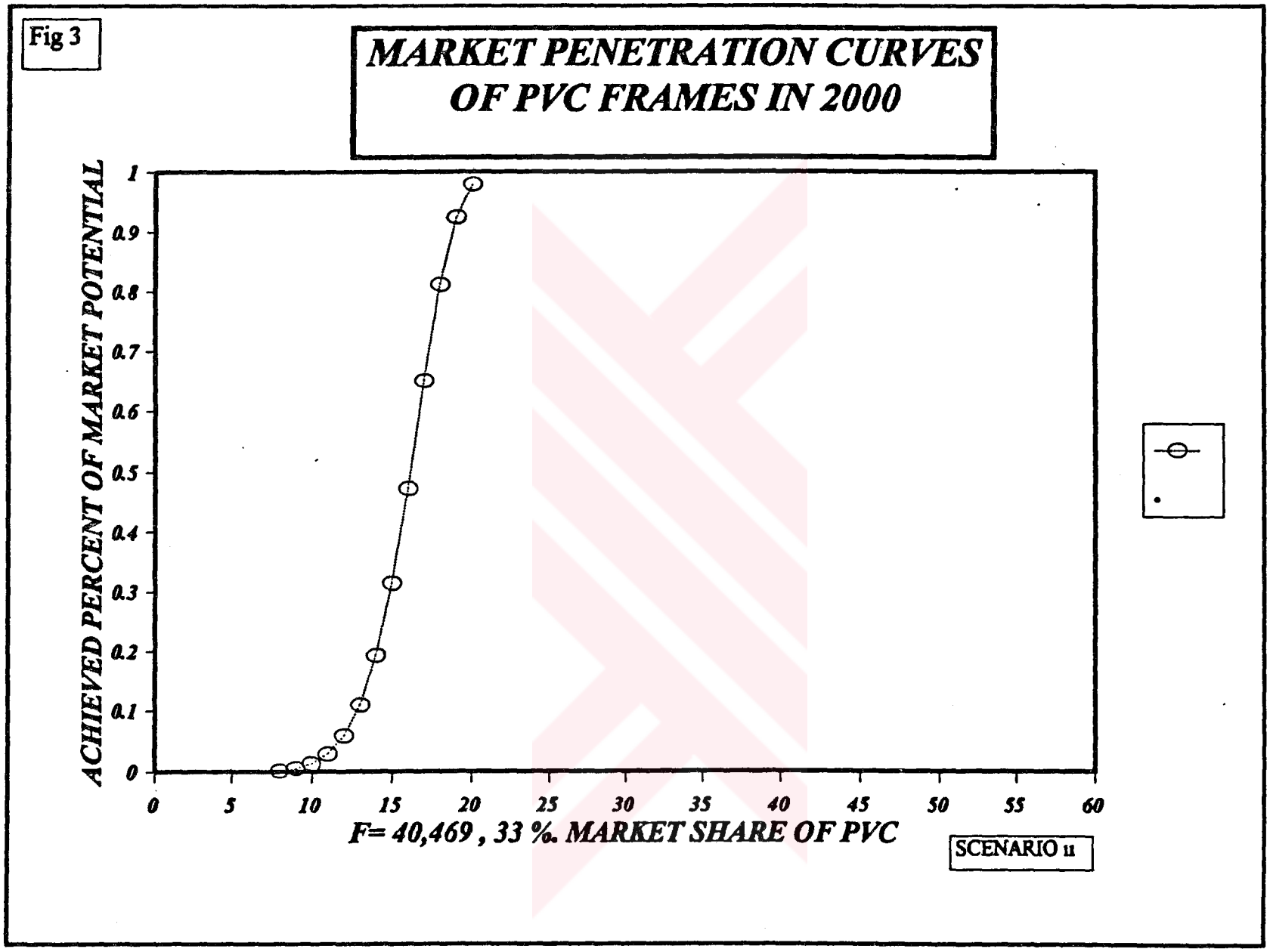

Fig3: Market Penetration Curve for Scenario II.

Fig 4

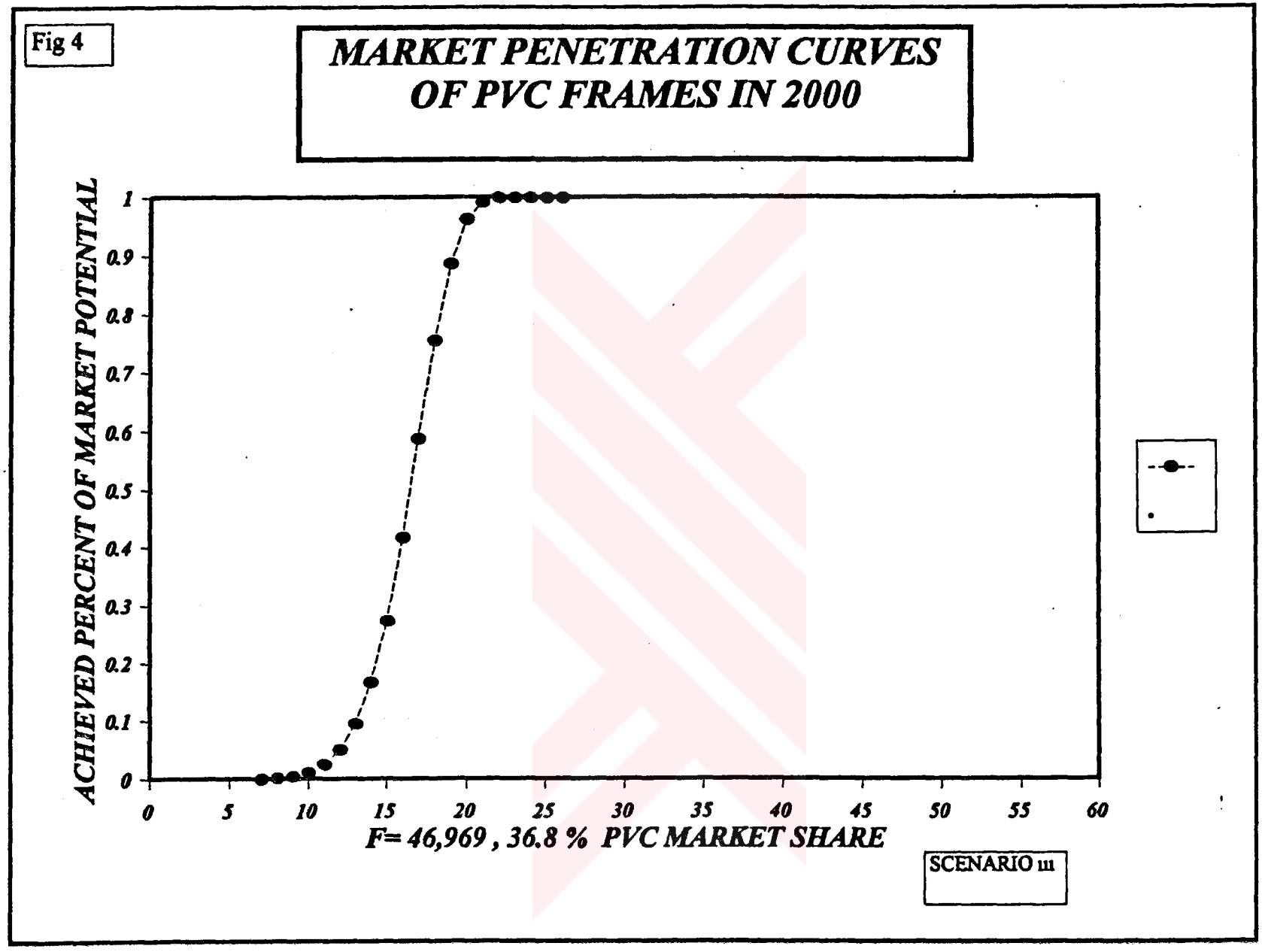

Fig4: Market Penetration Curve for Scenario III.

CHAPTER V

VALIDATION OF MODEL, COMMENTS ON RESULTS AND RECOMMENDATIONS

A. VALIDATION OF MODEL.

A model was chosen and adopted to PVC frame penetration problem. The model is based on Weibull Distribution, the details of which were given in Chapter III and the results are obtained in Chapter IV.

Validation of model results depends on validation of the model so the first attempt to test model is to perform the statistical evaluations. A series of statistical tests were applied to the results in order to validate the model. Detail on the tests and the results are given in Appendix-B and they are summarized in Table 19.

In three of the scenarios R-Squared values were found to be approximately 0.96. That means the Weibull Curve has fitted the available data excellently.

Calculated T ratios are greater than the values obtained from T-Table. It implies that the coefficients of predictor variables are significantly different from zero. In addition calculated F ratios are also found to be greater than those of F-table in each case, hence it can be claimed that obtained X coefficients are enough to predict the dependent variable.

Table 19: Statistical Test Results Of The Model

Scenarios	R-Squared	T-Ratio					F-Ratio				
		Calculated	Tables	d.f	α	Tail	Calculated	Table	d.f	α	Tail
I	.9215	9.693	2.306	8	0.05/2	Two	93.951	5.32	1,8	0.05	One
II	.9212	9.670	2.306	8	0.05/2	Two	93.508	5.32	1,8	0.05	One
III	.9594	9.623	2.306	8	0.05/2	Two	92.598	5.32	1,8	0.05	One

B. EVALUATION OF MODEL RESULTS

The scenarios are summarized with their outstanding characteristic in Table 20.

Table 20: Basic Characteristics & Assumptions Of Scenarios

Scenarios	Market Potential F (ton)	Market Share (%)	Saturation Times	Basic Assumption
I	38,068	31.5	2001	Except Retrofit and Irregular PVC
II	40,469	32.95	2001	Including Retrofit
III	46,969	36.8	2002	Including Retrofit and Irregular PVC

It is seen that the scenarios reflects different times to acquire the market potential completely. This times are found to be the year of 2001 for the first two of scenarios and found to be 2002 for the third.

Three of the market penetration curves, have a very steeper profile. That implies a rapid or fast market penetration which is provided as long as the yearly sales volume increase.

Of course it is difficult to estimate the actual market potential of the year 2000 exactly. It may be upper or lower than three of the considered scenarios in this study. However it can easily be concluded that the existing capacity will not meet the possible need, as a result the market penetration will be completed after 2000.

1. SWOT Analysis.

SWOT Analysis is a process of determining the external and internal strengths, weakness, opportunities and threats for an organization. In this study, SWOT analysis of PVC system frame sector will be made against the other type of frame sectors. When

the constructed model that reflects the general behavior of PVC frame sector is not wrong.

The result of the analysis will guide for each of the plastic frame producers.

a) Strength:

- Though it is a new product it takes attention as an alternative frame material and product awareness is quite high.

- Concept of PVC frame is nearly perceived as PIMAPEN which is product of PİMAS that is a well known and strong company. This creates a positive approach in minds.

- User preferences looks like leaning on PVC frames against wood and ordinary Al frames.

- PVC frames are really significant against the ordinary Al and wood frames.

b) Weakness:

- Technical deficiencies that occurs in fitting to building, creates a bad reputation. Because the most of the customers who have their window frames replaced complains about that kind of problems like not properly working windows, air and water filtration, being wet etc.

- The products of some small plastic profile producers may not satisfy the limits of Institute of Turkish Standards. The deficiencies that they possess increase undesirable technical problems and this will affect the consumer opinion in wrong direction.

- The used technology depends on foreign technology. It is not much more than a copy. By the reason that competition with foreign rivals is difficult.

c) Opportunities:

_ Our country is a developing country. That means there is a continuous need for a new an modern buildings. This creates a potential for frame need.

- In some certain regions of the country some of planned cultural buildings constructions are determined to be fitted with PVC frame as precaution against the problems caused by ordinary All frames which show dimensional changes according to ambient conditions and cause glass breaks.

_Increasing GNP per capita gives opportunity to the people so that they can think to have their old frames replaced.

- The increasing rate of marriages, divorces and population creates a potential need of new houses. That means there is an increasing potential for frame.

- The entity of irregular import profiles affect customer preferences to prefer domestic profiles.

- High prices of import profiles is a reason to be selected for domestic profiles.

d) Threats:

_ The entity of import profiles in our market creates a competition.

- In large commercial, cultural buildings Al based system frames are always more reasonable from many aspects. This will cause a big slice of frame potential is acquired by Al system frame sector.

C. COMMENTS AND RECOMMENDATIONS.

1. Strategic Success Factors:

The successful penetration of PVC frame profiles depends on many factors some of which are mentioned as follows:

a) The Quality: The local PVC frame systems should satisfy the international quality and performance standards in order to compete with imported PVC in Türkiye and to compete with the frames especially produced in European Countries as well.

b) Technology and R&D Activities: It is natural that the buildings in Turkiye differ from those of developed countries where they are constructed to satisfy the

international standards. Therefore some technical conflicts occurs in attaching the frame systems on to local building. The local PVC frame systems must be developed in order to eliminate this conflicts that occurs depending on the architectural design of the buildings in Türkiye.

c) Creativity and Fashion: Profiles may be developed in order to comply the different needs comes from different climatic conditions and different types of building.

d) Innovation and Care for Environment: PVC frames help to protect the national resources. They reduce the wood consumption for window frame in considerable rate. In order to keep the forest to follow an incentive policy by government may be recommended. The value added tax paid for imported PVC may be reduced. Therefore; the national wealth are protected and the new products are supported as well.

e) Company Image, Brand Image and Product Image: PVC system profiles are known to be the product of Pimaş that carried out all the pioneering works in Türkiye then the other producers take place in the market. The new product gained a positive image in minds as it is penetrated in to market by Pimas which is a respective PVC producer company. In order to protect this image one of the important things to do is training the personnel who serve in every steps of production and marketing system.

2. Proposed Strategies:

In order to compete successfully in the frame market the following strategies are recommended:

- Determine your target market appropriately.

- Bring innovations in existing product and develop them in order to satisfy the needs comes from architectural design of local buildings.

- Provide that the frame system will satisfy the international standards.

- Increase existing competition capacity both for domestic and foreign markets.

- Train the technician group.

- Eliminate the technical deficiencies occurs in attaching to building.

- Use most advanced technology in all step from producing profile to attachment of the frame to building.

- Try to keep the current fashion and be ready to response the possible expectation in future.

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APPENDIX A

DESCRIPTION OF THE NEW FORECASTING TECHNIQUE, IT'S APPLICATION AND RESULTS

DESCRIPTION OF THE METHOD:

$X_{max} - X_{min} = \rho$; is the difference between the maximum and the minimum datum.

$\rho / n - 1 = k$; is the yearly increment coefficient of next periods' forecast for next season.

$X = (X1+..+X_t) / n$; average of yearly demand.

$X_{(t+1)} = (X + k).\ X_t / X \quad (i=1.....t)$

$X_{(t+1)}$; forecast of $(t+1)^{th}$ period.

APPLICATION OF THE METHOD:

Calculations are based on following data.

t	$X_t (10^6)$
1	55.62
2	70.91
3	67.86
4	62.92
5	60.08
6	61.21

70.91 - 55.62 = 15.29 , ρ = 15,29 , n = 6 , 15,29 / 5 = 3.06, k = 3, 06

X = 378,6 / 6 = 63,1

$X_{(6+1)}$ = (63,1 + 3,06).55,62 / 63,1 = 58,32

$X_{(6+2)}$ = (66,16).70,91 / 63,1 = 74,35

$X_{(6+3)}$ = (66,16).67,86 / 63.1 = 71.15

$X_{(6+4)}$ = (66.16).62,92 / 63,1 = 65,97

$X_{(6+5)}$ = (66,16).60,08 / 63,1 = 62,99

$X_{(6+6)}$ = (66,16).61,21 / 61.3 = 64,18

To obtain the forecast for the year 2000 the method must be applied once more.

74,35 - 58,32 = 16,03, 16,03 / 5 = 3,21, k = 3,21.

X = 396,96 / 6 = 66,16

$X_{(12+1)}$ = (66,16 + 3,21).58,32 / 66,16 = 61,15

$X_{(12+1)}$ = (69,37).74,35 / 66,16 = 77,96

$X_{(12+1)}$ = (69,37).71.15 / 66,16 = 74,60 *

$X_{(12+1)}$ = (69,37).65,97 / 66,16 = 69,17

$X_{(12+1)}$ = (69,37).62,99 / 66,16 = 66,05

$X_{(12+1)}$ = (69,37).64,18 / 66,16 = 67,29

It is forecasted that expected construction potential for Turkiye in 2000, will be approximately $74.6x10^6 m^2$.

APPENDIX B

DESCRIPTION OF STATISTICAL TESTS AND STATISTICAL TEST RESULTS OF SCENARIOS.

DESCRIPTION OF STATISTICAL TESTS [24].

R-squared = r^2 = SSR/(SSR+SSE)

SSE: Sum of squares for error ($\sum_{i=1}^{n}=(y-\hat{y}_i)^2$).

SSR: Sum of square due to regression ($\sum_{i=1}^{n}=(\hat{y}_i-\bar{y})^2$).

F-ratio = MSR/MSE

MSR: Mean of square due to regression (MSR=SSR/k).

MSE: Mean of square due to error (MSE=SSE/(n-(k+1)).

k: Number of regression coefficients

n: Number of data

T-ratio = $\beta/\hat{s}_\beta$

β: Estimated x coefficient.

$\hat{s}_\beta$: Standard error of x coefficient.

HEADER DATA FOR: A:I LABEL: DATA OF SCENARIO I
NUMBER OF CASES: 10 NUMBER OF VARIABLES: 2

	X	Y
1	1.9459	-6.7399
2	2.0794	-6.1034
3	2.1972	-5.7172
4	2.3026	-5.4390
5	2.3979	-2.4123
6	2.4849	-2.0253
7	2.5649	-1.7667
8	2.6391	-1.3888
9	2.7081	-1.1142
10	2.7726	-.7654

---------- REGRESSION ANALYSIS ----------

HEADER DATA FOR: A:I LABEL: DATA OF SCENARIO I
NUMBER OF CASES: 10 NUMBER OF VARIABLES: 2

REGRESSION ANALYSIS

INDEX	NAME	MEAN	STD.DEV.
1	X	2.409	.276
DEP. VAR.:	Y	-3.347	2.350

DEPENDENT VARIABLE: Y

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF= 8)	PROB.
X	8.183	.844	9.693	.00001
CONSTANT	-23.062			

STD. ERROR OF EST. = .698
r SQUARED = .9215
r = .9600

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	45.806	1	45.806	93.951	1.071E-05
RESIDUAL	3.900	8	.488		
TOTAL	49.706	9			

	OBSERVED	CALCULATED	RESIDUAL	STANDARDIZED RESIDUALS -2.0 ... 0 ... 2.0
1	-6.740	-7.139	.399	
2	-6.103	-6.046	-.057	
3	-5.717	-5.082	-.635	
4	-5.439	-4.220	-1.219	
5	-2.412	-3.440	1.028	
6	-2.025	-2.728	.703	
7	-1.767	-2.074	.307	
8	-1.389	-1.466	.078	
9	-1.114	-.902	-.212	
10	-.765	-.374	-.391	

ADER DATA FOR: A:II LABEL: DATA OF SCENARIO II
MBER OF CASES: 10 NUMBER OF VARIABLES: 2

	X	Y
1	1.9459	-6.8011
2	2.0794	-6.1646
3	2.1972	-5.7784
4	2.3026	-5.5003
5	2.3979	-2.4762
6	2.4849	-2.0905
7	2.5649	-1.8332
8	2.6391	-1.4580
9	2.7081	-1.1862
10	2.7726	-.8425

---------- REGRESSION ANALYSIS ----------

HEADER DATA FOR: A:II LABEL: DATA OF SCENARIO II
NUMBER OF CASES: 10 NUMBER OF VARIABLES: 2

REGRESSION ANALYSIS

INDEX	NAME	MEAN	STD.DEV.
1	X	2.409	.276
DEP. VAR.:	Y	-3.413	2.346

DEPENDENT VARIABLE: Y

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF= 8)	PROB.
X	8.165	.844	9.670	.00001
CONSTANT	-23.086			

STD. ERROR OF EST. = .698
r SQUARED = .9212
r = .9598

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	45.611	1	45.611	93.508	1.090E-05
RESIDUAL	3.902	8	.488		
TOTAL	49.513	9			

	OBSERVED	CALCULATED	RESIDUAL	STANDARDIZED RESIDUALS -2.0 ... 0 ... 2.0
1	-6.801	-7.197	.396	
2	-6.165	-6.107	-.058	
3	-5.778	-5.145	-.634	
4	-5.500	-4.284	-1.216	
5	-2.476	-3.506	1.030	
6	-2.091	-2.795	.705	
7	-1.833	-2.142	.309	
8	-1.458	-1.536	.078	
9	-1.186	-.973	-.213	
10	-.843	-.446	-.396	

HEADER DATA FOR: A:III LABEL: DATA OF SCENARIO III
NUMBER OF CASES: 10 NUMBER OF VARIABLES: 2

	X	Y
1	1.9459	-6.9501
2	2.0794	-6.3137
3	2.1972	-5.9276
4	2.3026	-5.6495
5	2.3979	-2.6311
6	2.4849	-2.2483
7	2.5649	-1.9937
8	2.6391	-1.6241
9	2.7081	-1.3581
10	2.7726	-1.0250

---------- REGRESSION ANALYSIS ----------

HEADER DATA FOR: A:III LABEL: DATA OF SCENARIO III
NUMBER OF CASES: 10 NUMBER OF VARIABLES: 2

REGRESSION ANALYSIS

INDEX	NAME	MEAN	STD.DEV.
1	X	2.409	.276
DEP. VAR.:	Y	-3.572	2.336

DEPENDENT VARIABLE: Y

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF= 8)	PROB.
X	8.129	.845	9.623	.00001
CONSTANT	-23.156			

STD. ERROR OF EST. = .699
r SQUARED = .9205
r = .9594

ANALYSIS OF VARIANCE TABLE

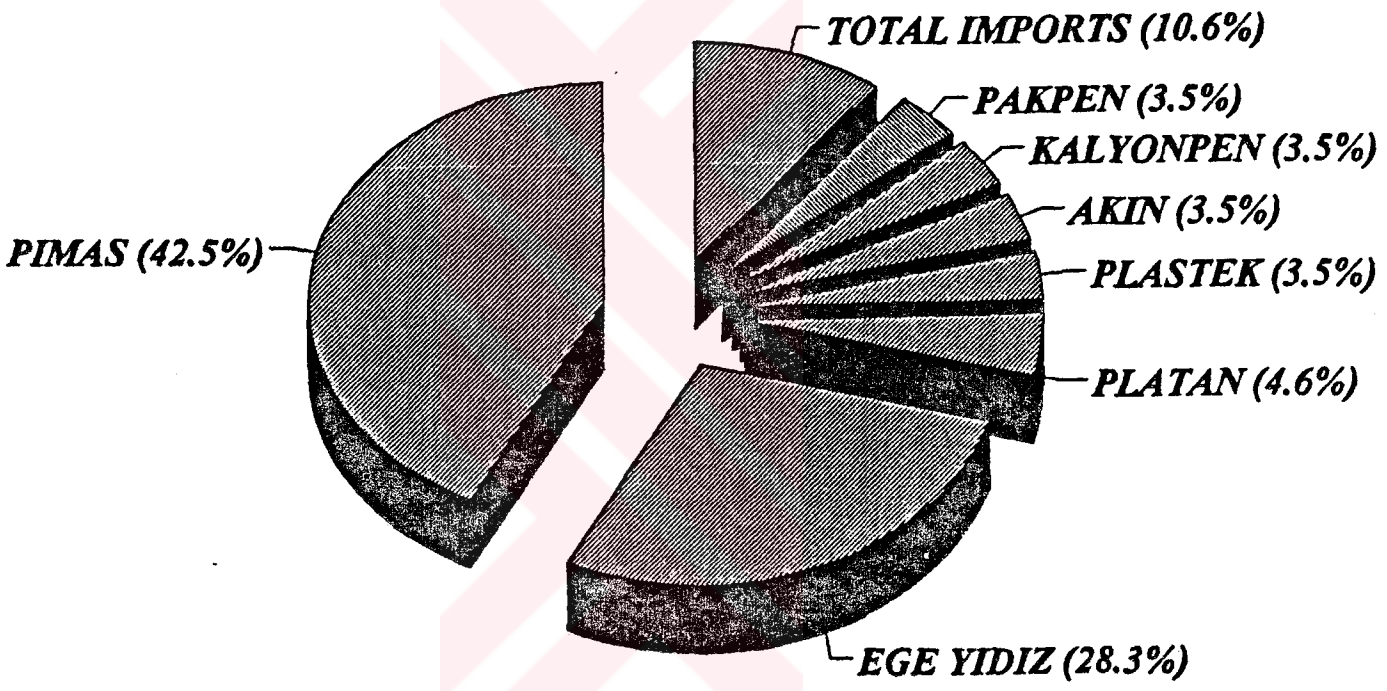
SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	45.200	1	45.200	92.598	1.130E-05
RESIDUAL	3.905	8	.488		
TOTAL	49.105	9			

	OBSERVED	CALCULATED	RESIDUAL	STANDARDIZED RESIDUALS -2.0 ... 0 ... 2.0
1	-6.950	-7.339	.388	
2	-6.314	-6.253	-.060	
3	-5.928	-5.296	-.632	
4	-5.650	-4.439	-1.210	
5	-2.631	-3.664	1.033	
6	-2.248	-2.957	.709	
7	-1.994	-2.307	.313	
8	-1.624	-1.704	.080	
9	-1.358	-1.143	-.215	
10	-1.025	-.619	-.406	

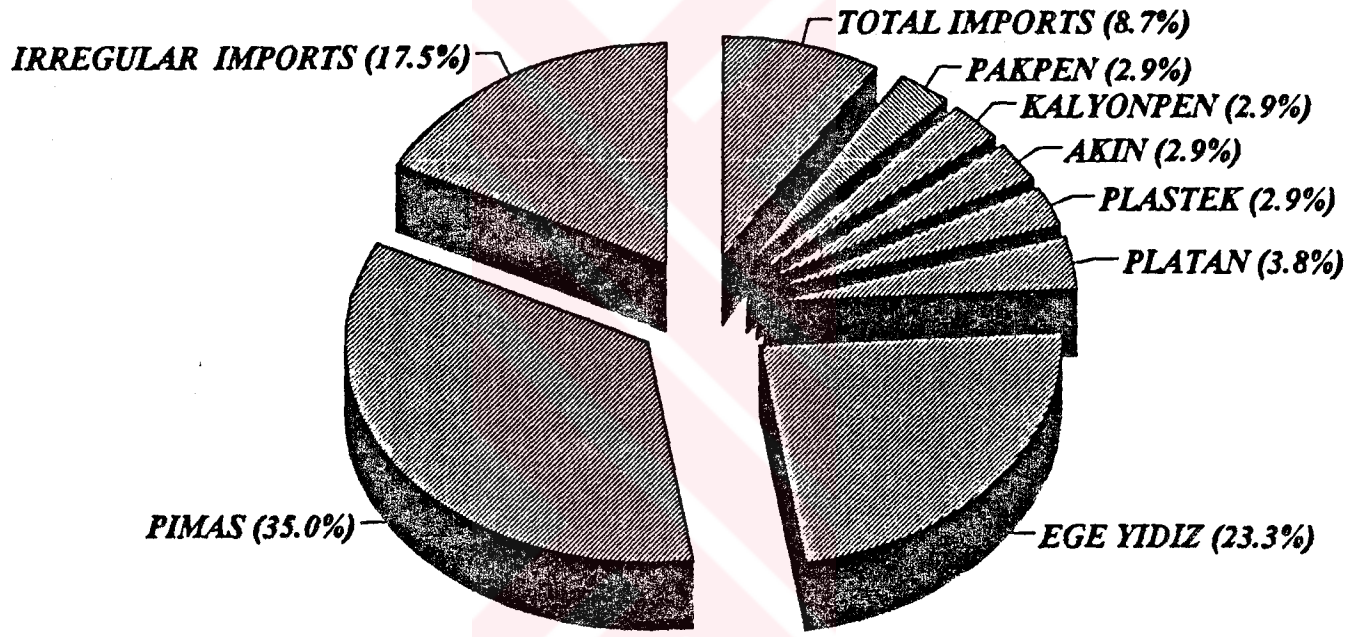
APPENDIX C

MARKET SHARE DISTRIBUTION OF PVC AND AL PROFILE PRODUCERS.

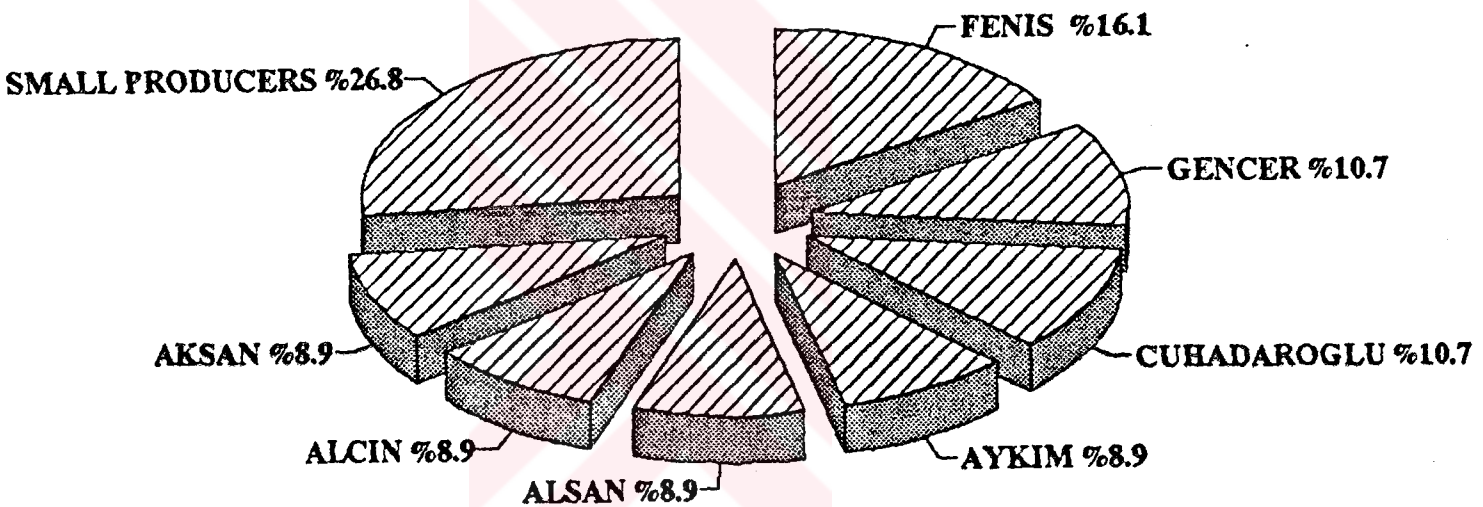
MARKET SAHARE OF PVC FRAME PRCRODUCERS 1992



MARKET SAHARE OF PVC FRAME PRCRODUCERS 1992 (INCLUDING IRREGULAR FRAMES)



MARKET SHARES OF AL FRAME PRODUCERS 1992

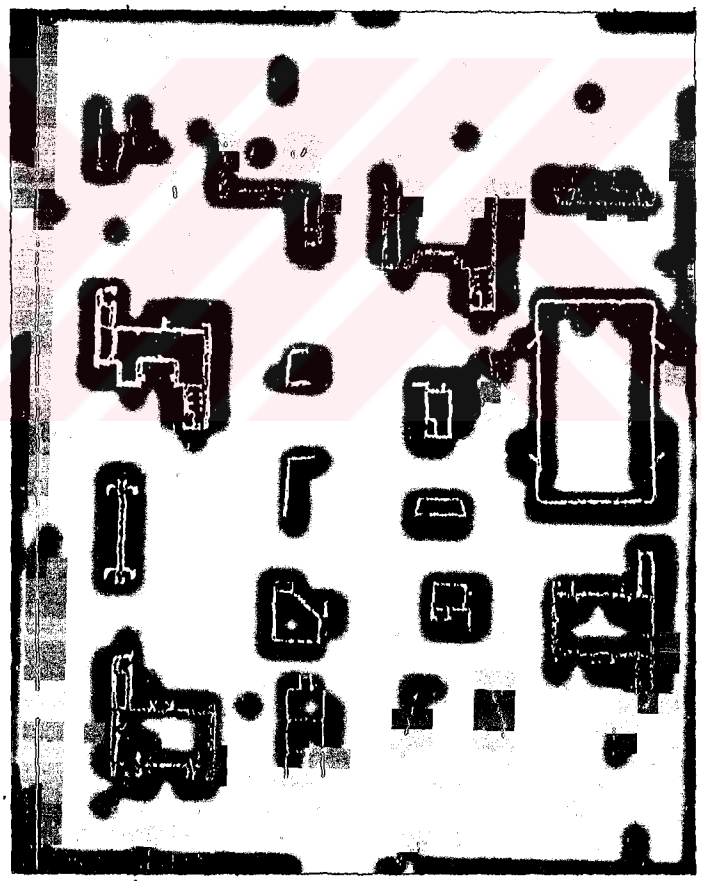


APPENDIX D

SAMPLES OF PVC SYSTEM FRAME BROCHURES AND CATALOGS

PİMAPEN

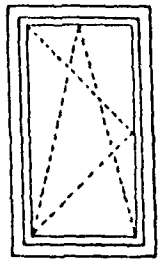
10-

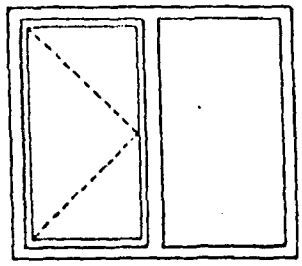


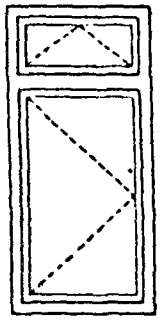
PİMAPEN

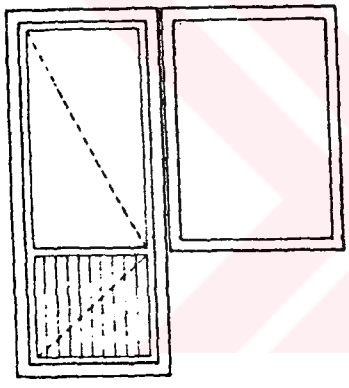
PENCERE SİSTEMİ

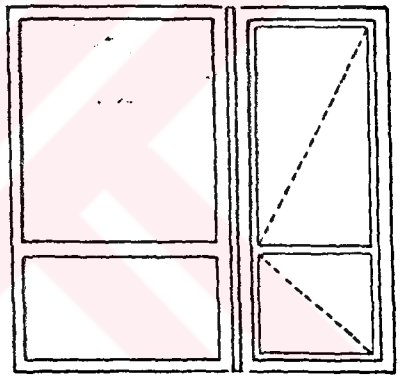
PENCERE ÖRNEKLERİ

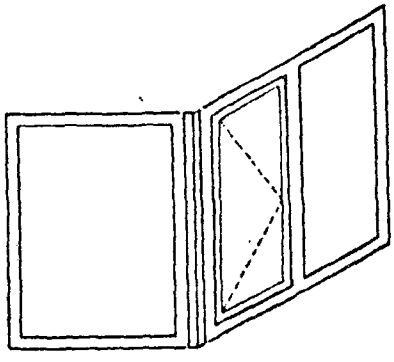












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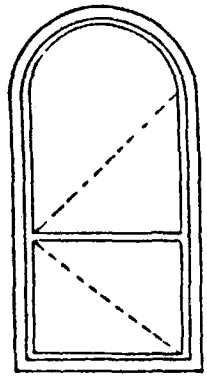
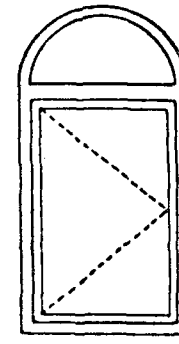
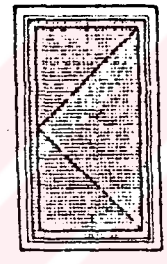
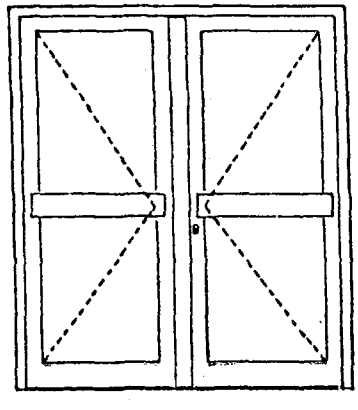
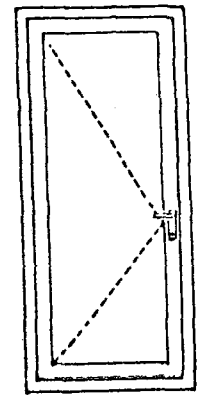
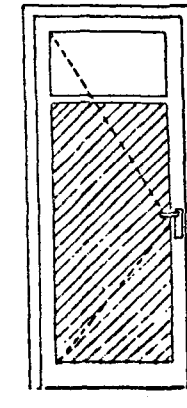




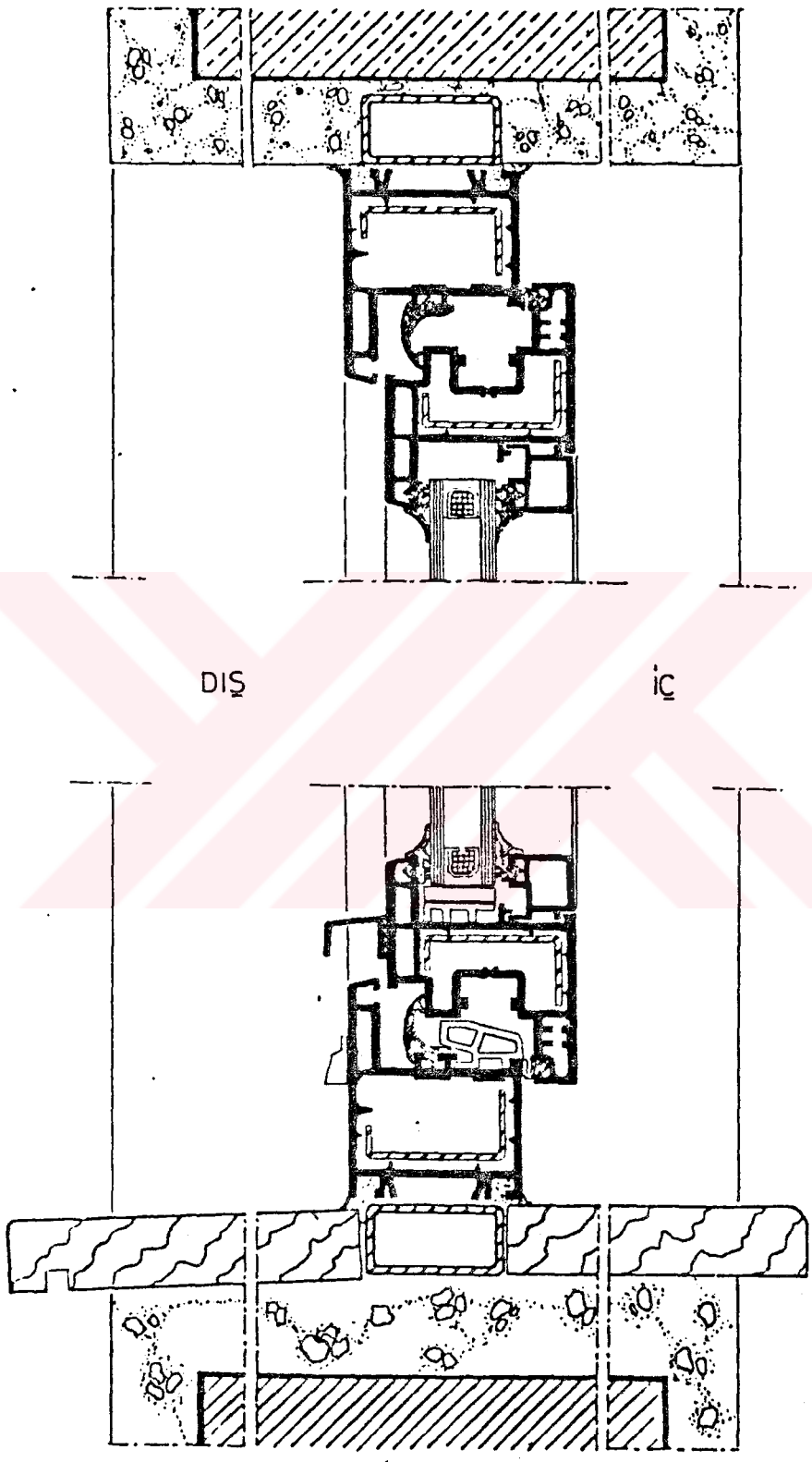








DÜZ KASA - KÖRKASALI UYGULAMA DÜŞEY KESİTİ Ö: 1/2



PİMAPEN PENCERE SİSTEMİ

Ülkemiz inşaat sektörünün endüstriyel anlamda örgütlenmesinin temelinde büyük çapta üretim, uluslararası standartlara uygun kalite ve mühendislik hizmetleri gelir.

Dünyada son 30 yıl içinde Plastik mamullerin gösterdiği gelişim hepimizce bilinmektedir. Bugün plastik en hassas cihazlardan, gündelik eşyaya kadar uzanan yaygın ve rakipsiz bir kullanım alanına sahiptir.

PİMAPEN Avrupa'daki benzerlerinin üstün özelliklerine sahip ve **PİMAŞ** kalite anlayışına uygun, EPDM contası, ispanyolet aksamı, menteşe ve vidasına kadar titizlikle imal edilmiş, pencere dizaynında ve üretiminde Batı Almanya standartları esas alınmış bir mamuldür. Sert PVC doğramalar Batı Almanya'da % 50, Avusturya'da % 40 gibi bir pazar payına ulaşmıştır.

PİMAPEN, inşaatı yapan ve kullanan açısından çeşitli problemler çıkartan bir konunun en yeni ve kesin çözümü olarak **PİMAŞ** tarafından ülkemiz inşaat sektörüne kazandırılmıştır.

PİMAPEN giderek önem kazanan enerji ve çevre kirlenmesi sorunları açısından pencerelerin tasarım ve üretimini dikkatle ele almıştır. Kullanıcı açısından özellikle **ısı kaybını önleyen, uzun ömürlü, yağmur, hava, toz ve ses geçirmeyen, bakım istemeyen** doğrama gerekmekte, inşaatı yapan açısından ise istenilen boyut ve ebatta doğramayı zamanında ve kolaylıkla temin etmek ve kısa sürede yerine takmak istenmektedir.

PİMAPEN, bugün Türkiye'nin her yanında, yurt dışında da Suudi Arabistan, Libya, Irak, Sovyetler Birliği ve Ürdün'de 1.000.000 m²'yi bulan bir kullanım alanına uleşmıştır. **Bayındırlık Bakanlığı Birim Fiyatlarında yer almaktadır.**

PİMAPEN Pencere Profilleri, Ultraviyole ışınlarına, soğuğa, sıcağa, kimyevi maddelere ve ateşe dayanıklı özel katkılı sert PVC'den imal edilmekte, içlerine metal takviye profilleri yerleştirilerek, profillerin yüksek rüzgar güçlerine karşı mukavemeti sağlanmaktadır. 120 km/h rüzgar ve yağmur altında izolasyon ve mukavemet değerleri açısından yapılan deneylerde en sağlıklı sonucu vermektedir.

PİMAPEN Pencere Sisteminde kanat aralıklarını iki kez çevreleyen EPDM conta ve geliştirilmiş ispanyolet sistemi, kanatlarda oluşan ısı kayıplarını en aza indirmektedir. Aynı doğramaya sadece cam çıtası değiştirilerek tek veya çift cam takılabilmektedir.

PİMAPEN Pencere Sisteminin ömrü binanın ömrü kadardır. Bir ayda 60.000 m² siparişi kabul edebilecek üretim olanaklarına sahip olan "**PİMAPEN**" Pencere Sistemi teknik kadrosu, servisi ve mühendislik hizmetleri ile ciddi bir hizmet anlayışına sahiptir.

SERT-PVC MADDESİNİN FİZİKSEL ÖZELLİKLERİ :

a) Ortalama Yoğunluk	1.38-1.4 g/cm³	(TS 201)
b) Uzunlamasına genleşme katsayısı	80.10⁻⁶/ C	(TS 201)
c) Isı iletkenliği	0.13 kcal/m²h°C	(TS 201)
d) Esneklik (Elastiklik) modülü	20.00 N/mm²	(TS 1398)
e) Yüzey Direnci	10 ¹² Ohm	(TS 201)
f) Çekme Mukavemeti	37,5 N/mm²	(TS 1398)
g) Çentik darbeli eğilme mukavemeti	13 KJm²	(TS 1004)

SERT-PVC MADDESİNİN KİMYASAL ÖZELLİKLERİ:

Asitlere, bazlara, yıkama maddeleri (deterjan, sabun) alkollere, yağlara (bitkisel ve hayvansal) karbonik asite, benzin ve suya dayanıklıdır.

Malzeme alev almaz, alev aktarmaz, ateş kaynağı uzaklaştığında alevi söner.

CONTA İZOLASYONU :

Kanat aralıklarını iki kez çevreleyen contalama sistemiyle ısı, nem, toz ve sese karşı gerçek bir izolasyon değeri sağlanır. B Alman Rosenheim deney enstitüsünde DIN 18055'e uygun ölçmelerde **PİMAPEN** kanat sızdırmazlık "a" değerinin sıfıra yakın olduğu tesbit edilmiştir. (Bkz. Yıldız Üniversitesi raporu.)

Kanat sızdırmazlık contaları EPDM (A.P.T.K.) kauçuk contadır. Özel üretim teknolojisi gereği yıllarca fonksiyonlarını devam ettirirler. Özel dizaynları gereği değiştirilmesi kolaydır. Eksenel olarak 3 mm kadar eğilme imkanları nedeniyle en gayri müsait iklim koşullarında dahi gerçek bir kapama sağlarlar.

Avrupa'da kullanılan sistemlerde olduğu gibi, **PİMAPEN** PVC Pencere Sisteminde de dış contalı ve orta contalı sistemler uygulanmaktadır. Her iki sistemde de çeşitli iklim koşullarında en yüksek geçirimsizlik sağlanmaktadır. Sistemlerde; detay gereği ön dış bölgeye gelen yağmur suyu, özel su tahliye kanalları ile dışarı atılmaktadır.

İSPANYOLET VE MENTEŞE:

PİMAPEN Pencere Sistemi'nde kullanılan ispanyoletler Avrupa standartlarına uygun olarak **PİMAŞ** tarafından üretilmektedir. Pencerelerde gerçek bir kilitleme sağlayan özel ispanyolet ve menteşe sistemi, çeşitli açılma imkanlarıyla da ülkemizde üretilen nitelikli doğrama malzemesidir.

PİMAPEN PENCERE SİSTEMİ ISI YALITIM DEĞERLERİ :

Malzemenin ısı yalıtım değeri 0,13'dür. Bu değer Ahşapın ısı yalıtım değerine eşdeğerdir. Doğrama malzemelerinin ısı yalıtım değerleri (DIN 4108)

AHŞAP 0.12 Kcal/m^{2}h^{0}C

Plastik 0.13 Kcal/m^{2}h^{0}C

Demir 50.- Kcal/m^2 h^{0}C

Alüminyum 175.- Kcal/m^{2}h^{0}C

Tablodan görüldüğü gibi metaller çok iyi ısı iletkenidirler. Bu nitelikleri dolayısıyla Bayındırlık Bakanlığının 30 Ekim 1981 tarihli yönetmeliğiyle yurt sathında doğrama malzemesi olarak kullanılması kısıtlanmış bulunmaktadır.

Çift camlı (Isıcamlı) **PİMAPEN PENCERE SİSTEMİ**'nin ısı yalıtım değerleri K= 2,6 Kcal/m^{2}h^{0}C'dir. (DIN 4108-TSE 2164). Bu değer özel birleştirilmiş çift cama (Isı cam'a) ait değerin bir pencere sistemi olarak sağlanması demektir.

Uygulamada çiftcam (ısıcam) tercihi yapılarak kazanılan ısı yalıtım kazancı ; doğrama malzemesinin niteliğinden veya conta izolasyonunun olmamasından dolayı kaybedilmektedir. **PİMAPEN** gerek ısı yalıtım değeri, gerekse conta izolasyonu ile bu kayıplara karşı bir çözüm malzemesidir.

PİMAPEN PENCERE SİSTEMİ SES YALITIM DEĞERLERİ

Alman Standartları DIN 4109 ve DIN 2719'a göre düzenlenen aşağıdaki tablolardan da görüldüğü gibi; çiftcamlı (ısıcamlı) PİMAPEN PENCERE SİSTEMİ 39 desibel'e varan yalıtım değeriyle en gürültülü ortamlarda dahi sessiz mekânlar oluşturur.

Çeşitli Pencere Tiplerinin Ses Yalıtım Değerleri (DIN 2719)

PENCERE TİPİ	Ses Yalıtım Değeri
12 mm hava boşluklu çift cam takılmış. Yalıtımlı doğrama profilinden çerçeveli ve kanat aralıklarında contalı yalıtım sağlanmış Pencere Sistemi (Örnek: PİMAPEN Pencere Sistemi)	35-29 d B
6 mm hava boşluklu çift cam takılmış, yalıtımlı doğrama profilinden çerçeveli ve kanat aralıklarında contalı yalıtım sağlanmış Pencere Sistemi. (Örnek: PİMAPEN Pencere Sistemi)	30-34 d B
Kanat aralıklarında contalı yalıtım olmayan, ısı yalıtımlı doğrama profilinden çerçeveli pencereler. (Örnek: Ahşap Doğramalar)	24 d B

YAPI DIŞ CEPHELERİNDE GÜRÜLTÜ SEVİYELERİ ORTALAMA DEĞERLERİ (DIN 2719)

1		2	3	4	5	6	7
		MEKÂNLAR					
Gürültü Sınıflandırmaları	Gürültü Seviyeleri db (A)	Hastane ve Sanatoryumlarda Yatak odaları		Konut oturma odaları, Hotel Yatak odaları, Dersaneler		Büro çalışma odaları	
		Gerekli (Ses) Gürültü Yalıtım Değerleri RW (Dış duvarlar için) RW (Pencereler için)* db olarak					
		Dış duvar	Pencere	Dış duvar	Pencere	Dış duvar	Pencere
I	≤50	30	25	30	25	30	25
II	51-55	35	30	30	25	30	25
III	56-60	40	35	35	30	30	25
IV	61-65	45	40	40	35	30	30
V	66-70	50	45	45	40	35	35
VI	>70	55	50	50	45	40	40

PİMAPEN PENCERE SİSTEMİ NEM İZOLASYON DEĞERİ:

Batı Alman Pencere Tekniği Enstitüsü (Institut Fenster Technik-Rosenheim) tarafından PİMAŞ-PİMAPEN PENCERE SİSTEMİ'nin Batı Alman standartı DIN 18055'e (Pencereler ve aralıklarının hava geçirgenliği, çarpma yağmur sızdırmazlığı, şartları ve test metodları'na) uygun olarak deneyleri yaptırılmıştır.

Bu deneylerde çok yüksek rüzgar hızlarına benzer şartlar yaratılarak hava sızması ölçülmüş ve bu değerlerin saptanmış limitlerin altında olduğu belirlenmiştir. Ayrıca çok yüksek basınçlı çarpma yağmur etkisinde iç bölmelere hiç su sızdırmadığı görülmüştür.

PİMAPEN PENCERE SİSTEMİ'nin contalı izolasyonu sayesinde yüksek izolasyon değeri bu deneyle bir kez daha saptanmıştır.

T.C.
İSTANBUL TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜ
Makina Fakültesi

Sayı : 90/1451

Firma : PİMAŞ Plastik İnş.Malzemeleri Anonim Şirketi

İSTANBUL
31.7.1990

İlgi : 4.6.1990 tarih, 027/I-A-57 sayılı yazınız.

-İlgide belirtilen müracaatınız üzerine Dekanlığımızca görevlendirilen öğretim elemanları :

Prof.Dr.Alpin Kenal PAŞAOĞLU.....

.....

.....

tarafından düzenlenmiş bulunan.....3.7.1990.....tarih.90/1451 sayılı rapor ekte sunulmuştur.

Bilgilerinizi saygılarımla rica ederim.

Prof.Dr.Yaşar ÖZMİR
Dekan

ÖZET

Pencerelerdeki ısı kaybı, Pimapen doğrama kullanılması halinde ahşap doğramaya nazaran % 33-55 , normal aluminyum doğramaya nazaran % 25-39 arasında azalmaktadır.

Pimapen doğrama kullanılmasıyla, kelorifer tesisatında özellikle

. daha az sayıda radyatör dilimi ve grubu

. daha küçük kazan, genişleme kolu, kolon ve radyatör vanaları, boru çapları, sirkülasyon pompası

kullanılacağından maliyet düşecektir.

Pimapen doğrama kullanılmasıyla yakıt sarfı da azalacak olup, pencere başına ahşap doğramaya nazaran 144 kg, aluminyum doğramaya nazaran 75 kg'a varan senelik fuel-oil tasarrufu sağlanabilecektir. Büyük bir apartmanda ise neticede senelik 23 ton fuel-oil tasarrufu olacağı hesabedilmiştir.

Pimapen doğramanın Ülkemizde yaygın şekilde uygulanması sonucunda, gerek sağlanacak yakıt tasarrufu ve gerekse son yıllarda tehlike sınırlarını sık sık aşan hava kirliliğinin azaltılması Ülkemizin ekonomisi ve vatandaşlarımızın sağlıkları yönünden çok önemli olduğu şüphesizdir.

TÜRK STANDARDLARI ENSTİTÜSÜ

TÜRK STANDARDLARINA UYGUNLUK BELGESİ

ENSTİTÜMÜZ İLE [illegible] MÜESSES
PİMAŞ PLASTİK İNŞAAT MALZ. A.Ş.
ARASINDA YAPILAN SÖZLEŞME GEREĞİNCE FİRMAYA BUNDAN BÖYLE
20 EYLÜL/ARALIK 1987 "SERT PVC PROFİLLER-PENCERE VE [illegible]
STANDARDINA UYGUN OLARAK İMÂL EDECEĞİ
P İ M A P E N MARKALI MAMÛLLERİ
ÜZERİNE TSE MARKASI KOYMA YETKİSİ TANINMIŞTIR.
BU MARKA ÜZERİNE KONULDUĞU MAMÛLÜN TÜRK STANDARDLARINA UYGUNLUĞUNU İFADE EDER.

ÜZERİNE TSE MARKASI KONULMASINA İZİN VERİLEN MAMÛLLERİN ADI, SINIFI, TÜRÜ VE ÖZELLİKLERİ

- SERT PVC PROFİLLER-PENCERE VE [illegible] KAPI YAPIMINDA KULLANILAN.

TÜRK STANDARDLARI ENSTİTÜSÜ
Genel Sekreteri
HÜLMİ İSMAİLOĞLU

TÜRK STANDARDLARI ENSTİTÜSÜ
Başkanı
MEHMET NİZAMİ AKSÖZER

VERİLİŞ TARİHİ : 7.6.1990

7/6/1990	——19	——19	——19
YIL VİZESİ	YIL VİZESİ	YIL VİZESİ	YIL VİZESİ

BU BELGE EN SON VİZE TARİHİNDEN İTİBAREN BİR YIL GEÇERLİDİR. YILLIK VİZESİ YAPILMAYAN BELGE GEÇERSİZDİR.

Tarih : ...../.....19.....

EGE PEN PENCERE SİSTEMLERİ

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Sicil Ticaret : 262347/209919

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EGE PEN
PENCERE SİSTEMİ
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Tarih : ...../.....19.....

EGE PEN PENCERE SİSTEMLERİ

Ege Pen ülkemiz pencere sektöründe 3 önemli üstünlüğe sahiptir.
— Ege Pen pencere profilleri ön odacıklı olarak dizayn edilmiştir.
— Ege Pen pencereleri körkasalı montaja uygundur.
— Ege Pen'in geliştirdiği sistemler prefabrik ve prekast yapı elemanlarına kolaylıkla monte edilir.

Ön odacık profilin metal takviyeli asıl bölümü ve bu bölgedeki metal takviye profilini dış etkenlerden korur. Bu bölgedeki termik gerilmeler en aza iner. Metal takviye profilinin termik gerilmelere karşı korunması, profil materyali özelliklerinin uzun yıllar korunmasını ve hizmet etmesini sağlar.

Ön odacıklı profil dizaynı sayesinde, tek bölümlü profillere göre daha iyi ısı izolasyon değeri sağlanır. Önodacık ilave ısı yalıtım bölgesi demektir. EGE PEN size içten dışa iki bölgeli ve 56 mm. genişliğinde ısı yalıtımı sunar. Plastik pencereler için Alman DIN Standartlarınca kabul edilen ısı yalıtım değerleri EGE PEN'in asgari ısı yalıtım değeridir. (k=1,9 W/m² K). EGE PEN kanat aralıkları içten ve dıştan çepeçevre iki kez contalanır. Bu sayede gerçek bir fuga izolasyonu sağlanır. (a:0,1 m³/h/m). Bu tür kanat izolasyonu dünyada ve ülkemizde en yaygın ve geçerli izolasyon sistemidir.

Ön odacıksız tek bölümlü doğrama profillerinden yağmur suyu tahliyesi; direkt su tahliye kanalı ile olur. Yüksek yapılarda oluşacak C ve D klasman yüksek rüzgar güçlerine karşı direkt su tahliye kanalı aynı zamanda ters yönde çalışır. Su tahliye kanalından soğuk rüzgar ve rüzgarlarla birlikte gelen çarpma yağmur suyu bu kanaldan cam yuvasına geri teper, camı soğutur, cam buğulanır, camda terleme suyu oluşur, camın (çift camın) izolasyon değeri düşer.

EGE PEN pencere sistemine ön odacık sayesinde uygulanan endirekt su tahliye sistemleri bu önemli sakıncayı önler. Ön odacıklı profil dizaynı çağdaş plastik doğrama sistemlerinin vazgeçilmez dizayn şeklidir.

EGE PEN Pencere Sistemi Körkasalı Montaja uygundur.

Körkasasız montajlarda pencere safhasına gelen inşaat, pencerenin montajını beklemek zorundadır. İnşaatta pencere takılması sırasında, öncesinde veya sonrasında meydana gelebilecek gecikmeler üzücü sonuçlar doğurur. Pencere takıldı mı, Diğer sorunlar başlar, conta yuvasına harç dolar, contalar kirlenir, fonksiyonları azalır. Boya-sıva derken pencerede önemli ölçüde bitmeyen bir temizlik başlar. Pencerede çizikler artar, camlar kirlenir, kir üstüne kir sonunda pencereniz arzu ettiğiniz kalitede değildir.

Körkasalı pencere montajında bu mahzurlar olmaz, inşaat devam eder. İnşaattan el ayak çekilip kir pas kalmayınca pencere montajına geçilir. Bir resim çerçevesi kalitesinde takılan EGE PEN pencere çerçevesi evlerinizin değerine değer katar.

EGE PEN pencere sisteminin bu üstün özelliklerini bir kez daha belirtelim.

1- **Önodacıklı Profil Dizaynı**
   * Yüksek ısı yalıtım değeri
   * Endirekt su tahliyesi
   * Endirekt çarpma yağmur hareketi

2- **Körkasalı Pencere Montajı**
   * Yüksek kalite pencere çerçevesi
   * İnşaat gecikmelerinde pencere sebebinin ortadan kalkması
   * Arzu ettiğinizde körkasasız EGE PEN 101 Serisi

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EGE PEN DOĞRAMALARIN ÜSTÜNLÜKLERİ

EGe Pen pencere doğramalarında rakiplerinde olmayan kasa kanat arasında conta sistemi mevcuttur.

Profil ağırlıkları benzerlerine göre daha ağırdır.

İstisnasız her profilin içine galvanizli metal saç takviye yerleştirilmiştir.

Metal takviye saçları çinko alüminyum karışım ile 40-50 mikron kalınlıkta galvanizlenmekte çürüme ve paslanma önlenmektedir.

Ege Pen kemerli pencere ve kapı üretimini Türkiye'de ilk geliştiren kuruluştur.

Damlalıklı pencere kanadı üretiminde Ege Pen Türkiye'de tek ve rakipsizdir. Profil kendinden damlalıklı olarak üretilmektedir.

Profil üzerindeki damlalık çıkıntısı yağmur suyunun uzaklaştırılmasında önemli rol oynamaktadır. Damlalık çıkıntısı kanat yüzeyinden süzülen yağmur sularının kanat ile kasa arasına girmesini önlemektedir. Damlalıklı kanat profili ile geniş açıklıkları geçmek mümkün olmaktadır.

Ege Yıldız profilleri ile kapı, pencere doğramalarının dışında, vitrin, duvar ve tavan kaplamaları, bölme duvarları, büro bölmeleri ile çeşitli dekorasyon işleri de yapılmaktadır.

Ege Pen ürünleri rakiplerine göre en son teknoloji ile tesis edilmiş İzmir, İstanbul (5 adet) Ankara, Bursa, Denizli, Konya, Bolu, Afyon, Adana Giresun, Manisa, Gebze ve Gaziantep fabrikalarında üretilmektedir.

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PENCERE SİSTEMİ
YETKİLİ SATICISI

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EGE PEN NEM İZOLASYONU

Kanat aralıklarını iki kez çevreleyen iç ve dış contalama sistemiyle dış hava koşullarına, ısı, ses, nem gürültü tesirlerine karşı gerçek bir izolasyon değeri sağlanır. Bu izolasyon sistemi dünyada ve yurdumuzdaki en yaygın kullanım şeklidir.

Üretici firma tavsiyesine uygun kapama mekanizmaları kullanılması halinde kanat aralıkları izolasyon değerleri en gayrimüsait rüzgar hızlarında dahi a= 12 m³h/m değerlerini aşmaz.

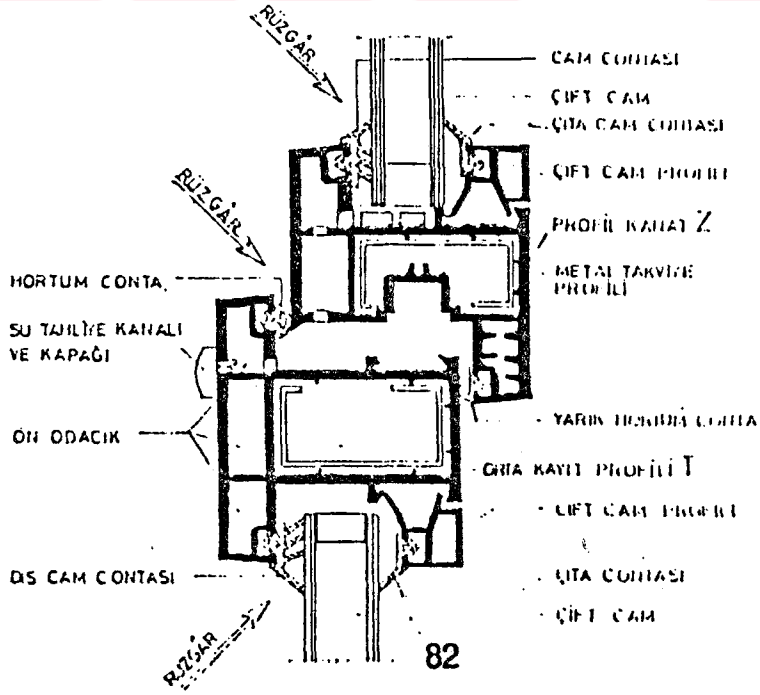
Yüksek rüzgar güçleri altında sızacak, bir miktar su damlacığı, su tahliye kanalı ile tahliye edilir.

Profil dizaynındaki önodacık sayesinde su tahliyesi endirekt su tahliye kanalı ile yapılır. Ayrıca, çıkış bir kapakçık ile direkt rüzgara karşı korunur.

Endirekt su tahliyesi, endirekt rüzgar hareketi demektir. Dışa açılımda rüzgar kapağı ile korunan endirekt tahliye kanalı sayesinde C ve D klasmanı yüksek rüzgar güçlerine karşı yüksek izolasyon değerleri sağlanır.

Önodacığı olmayan tek gözlü profillerde su tahliyesi direkt olur. Bu aksi istikamette rüzgar girişine de direkt açık bir kanal oluşması demektir. Özellikle sabit (açılmayan) camlı pencerelerde cam yuvasına rüzgar ve çarpma yağmur dolar. Isıcam'da (çift camda) iç cam yüzeyi soğur ve terler. Cam yüzeyinin izolasyon değeri düşer.

EGE PEN NEM IZOLASYONU



Kayışdağı Cad. No. 80/A Atamtürk Apt. 81040 Kuyubaşı - Kadıköy/İstanbul Tel.: 347 25 72 - 347 40 60
Sicil Ticaret : 262347/209919

PLASTİK PENCERE SİSTEMLERİ
SANAYİ VE TİCARET LTD. ŞTİ.

EGE PEN
PENCERE SİSTEMİ
YETKİLİ SATICISI

Tarih : ...../.....19.....

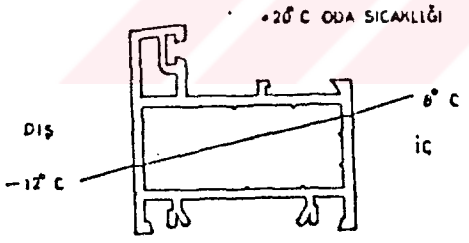
EGE PEN ISI YALITIM DEĞERLERİ

B. Alman Standardı 4108'e göre çeşitli malzemelerin ısı iletkenliği kat sayıları şöyledir.

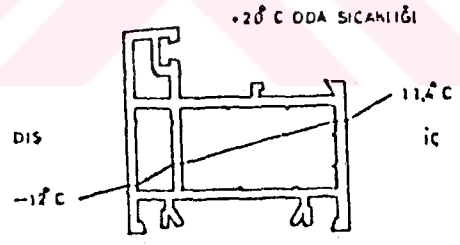
MALZEME	ISI İLETKENLİĞİ (W/mk)
Delikli Tuğla (1200 kg/m³)	0.52
Cam	0.81
Çelik	60.00
Alüminyum	
Ahşap	0.20
EGE PEN (Sert PVC)	0.16

EGE PEN pencere sistemi çift cam (ısı cam) takılmış haliyle ısı yalıtım değeri k=1.9 W/m². K'dir. Bu değer önodacıklı (çok odacıklı) doğrama profillerinin ortak değeridir. Önodacıklı profil dizaynının sağladığı endirekt su tahliyesi, endirekt rüzgar hareketi ve ön yalıtım bölgesi sayesinde bu yüksek ısı yalıtım değeri elde edilir.

EGE PEN profillerindeki önodacık bölgesi, önyalıtım bölgesi olarak en soğuk kış günlerinde dahi profilin iç yüzeyini sıcak tutar. DIN 4701'e uygun olarak gerçekleşen iç yüzey ısısından dolayı terleme olmaz.



TEK ODACIKLI PROFİL



ÖN ODACIKLI PROFİL (ÖR. EGE PEN)

Tek odacıklı ve ön odacıklı (çok odacıklı) profillerde iç ve dış ısıya bağlı ısı dağılımı diyagramı.

EGE PEN GÜRÜLTÜ İZOLASYONU

İstenmeyen seslerin izolasyonunda, cam kalınlığı, ısı camda iki cam arasındaki hava boşluğu, kasa-kanat aralıklarının geçirgenliği önem kazanır.

EGE PEN gürültü izolasyon değeri 30-34 Desibel'dir. Bu değer sayesinde en gürültülü ortamlarda dahi yalıtılmış sessiz mekanlar oluşur.

Çift camlardan bir tanesini diğerinin ikl katında seçersek EGE PEN'in izolasyon değeri 3-4 desibel daha artarak 34-38 desibele ulaşır.

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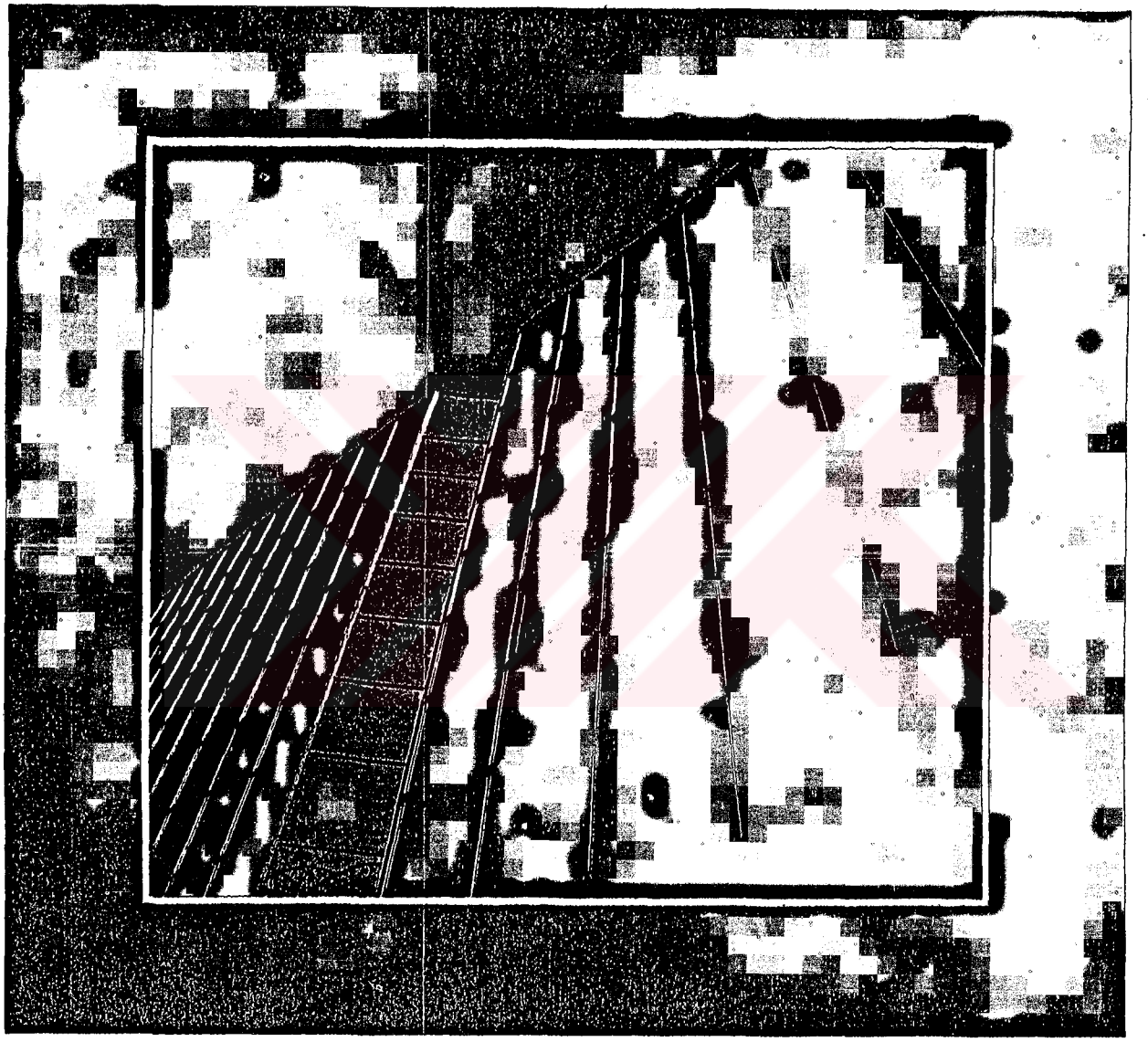
APPENDIX E

SAMPLES OF AL SYSTEM FRAMES BROCHURES AND CATALOGS



FENİŞ SİSTEM VE AKSESUAR A.Ş.

Aluminium is a versatile, malleable, incredibly strong, long-lasting, corrosion-resistant and durable metal.

Since 1963, Feniş has been applying the latest techniques in its processing of this durable modern age metal, to increase its aplication in Turkey, in the form of profiles, accessories and frames.

Feniş Systems and Accessories Inc., emerged from the Feniş nucleus in 1983. Its aim: To fullfill an ever increasing demand from the market place, with the finest available service in its field.

After much study and intensive research, a "know-how" agreement was signed between Feniş Systems and Alcan, one of the leaders in the aluminium world. The purpose of this agreement is to disseminate their combined advanced techonology throughout Turkey.

Feniş Systems and Accessories, Inc., renders technical service in four main areas:

a- The furnishing of project, detail and technical advice and consultancy in aluminium frames, to domestic and foreign contractors,

b- The technical marketing of framing systems,

c- All aspects of contractual work abroad, vis-a-vis aluminium frames,

d- The establishment of its own agencies within foreign companies.

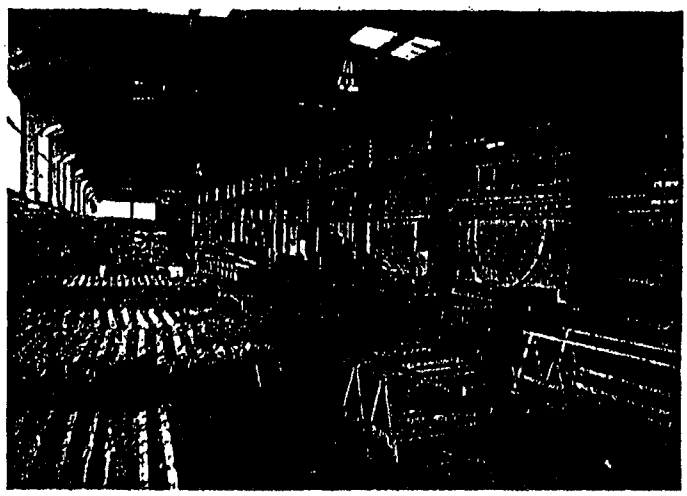
Feniş Systems serves the domestic market through "authorized aluminium framing firms" which have been selected with special care.

WHAT IS FENİŞ "SYSTEM FRAMING"?

In aluminium framing, "system" means the use of materials, manpower and time in the most productive manner during the manufacture and/or fitting of frames. It applies throughout the process, from the selection and fitting of the smallest bolt or screw, right through each accessory component, to the emergence of the finished product.

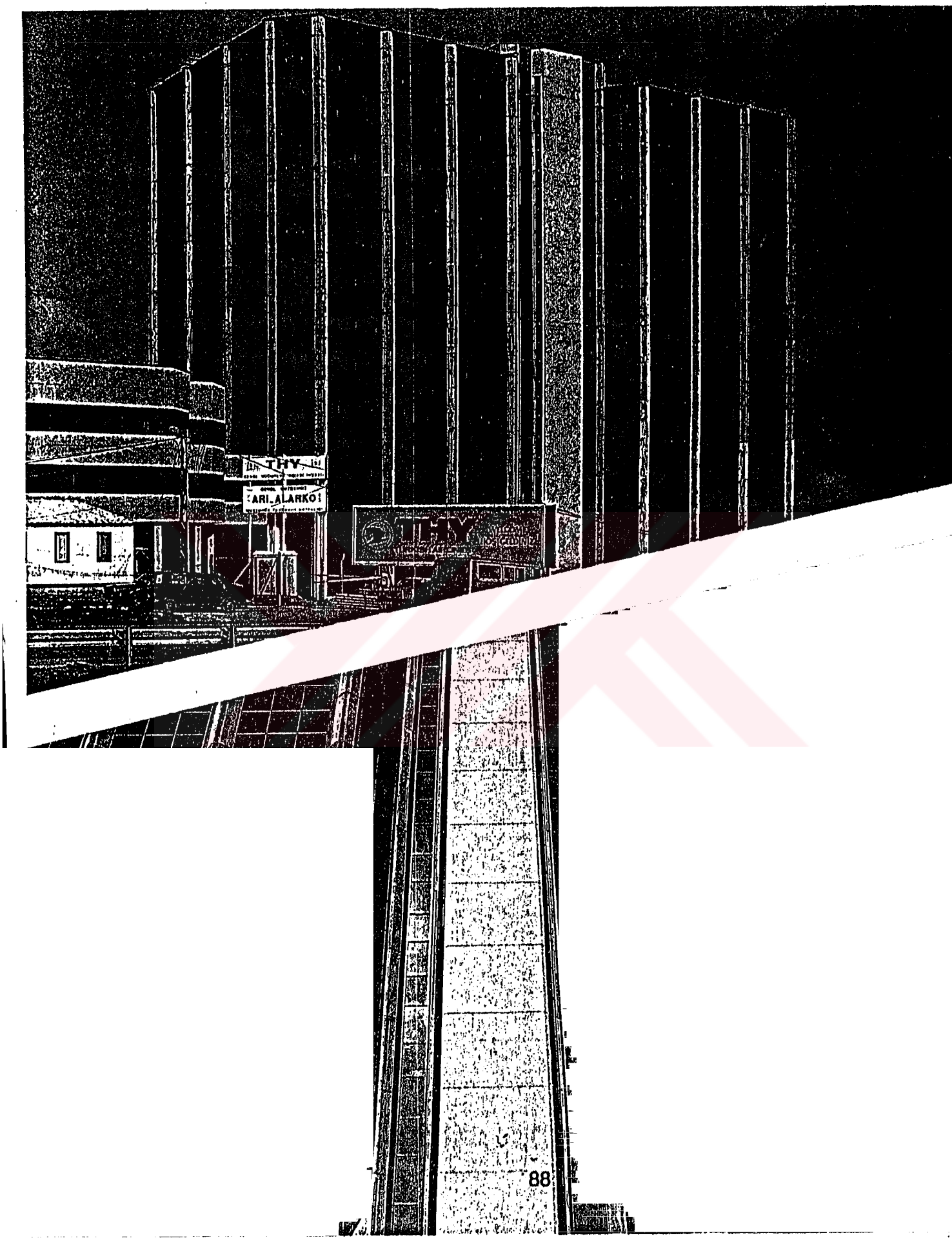
Aluminium frames have become such an integral feature of the modern age that constant resarch is being undertaken to develop them further.

In "System Framing" rigorous standards of care and expertise are used and maintained in all aspects of production. From the selection of raw materials, through functional efficiency tests, the application of reinforcement elements, accessory development (always with a view to increasing durability) -from the smallest detail to the whole highly functional and elegant unit which emerges at the end of the production process- all are subjected to and must satisfy "System Framing's" exacting standards.

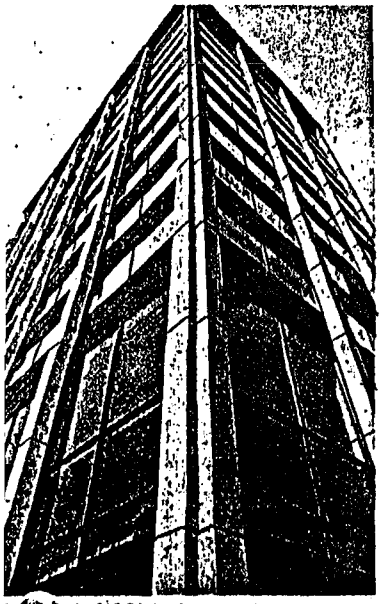


In the Ministry of Civil Works' unit prices manual, Feniş "Systems Framing" is listed under the following headlines:

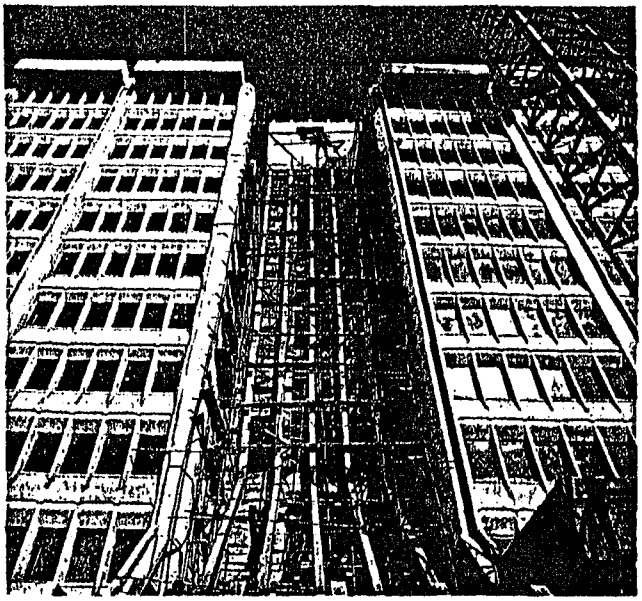
23-244 system framing without insulation
23-244/1 system framing with insulation



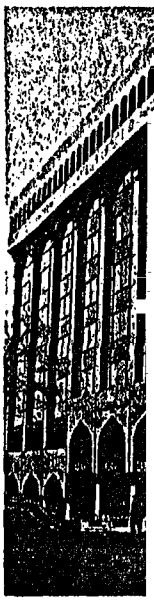
THY BUILDING
SYSTEM: TF1400 CURTAIN WALLS



AN[illegible]OLU SİGORTA BUILDING
SYSTEM: S6000 WINDOWS



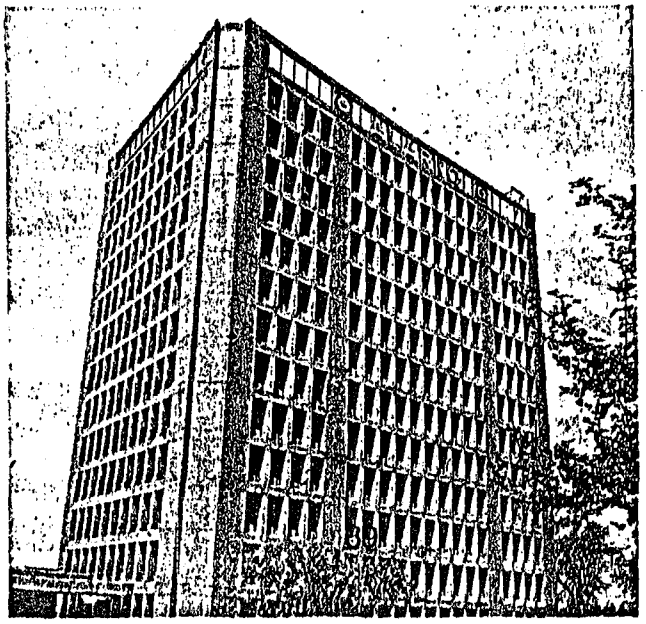
GAYRETTEPE BUSINESS CENTER
SYSTEM: T8500 THERMAL BREAK WINDOWS



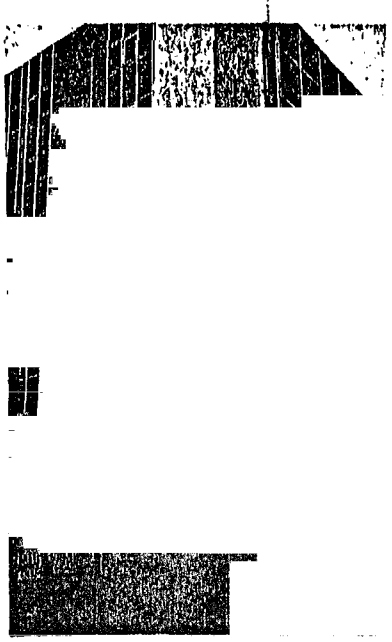
ARAP-TÜRK BANK
SYSTEM: S5000 SLIDING WINDOWS
S6000 WINDOWS

O[illegible]ENVELOPE FACTORY
SYSTEM: S5000 SLIDING WINDOWS-TF1400 CURTAIN WALLS

NOVA BARAN PLAZA
SYSTEM: TF1400 CURTAIN WALL



ALARKO BUILDING
SYSTEM: S6000 WINDOWS

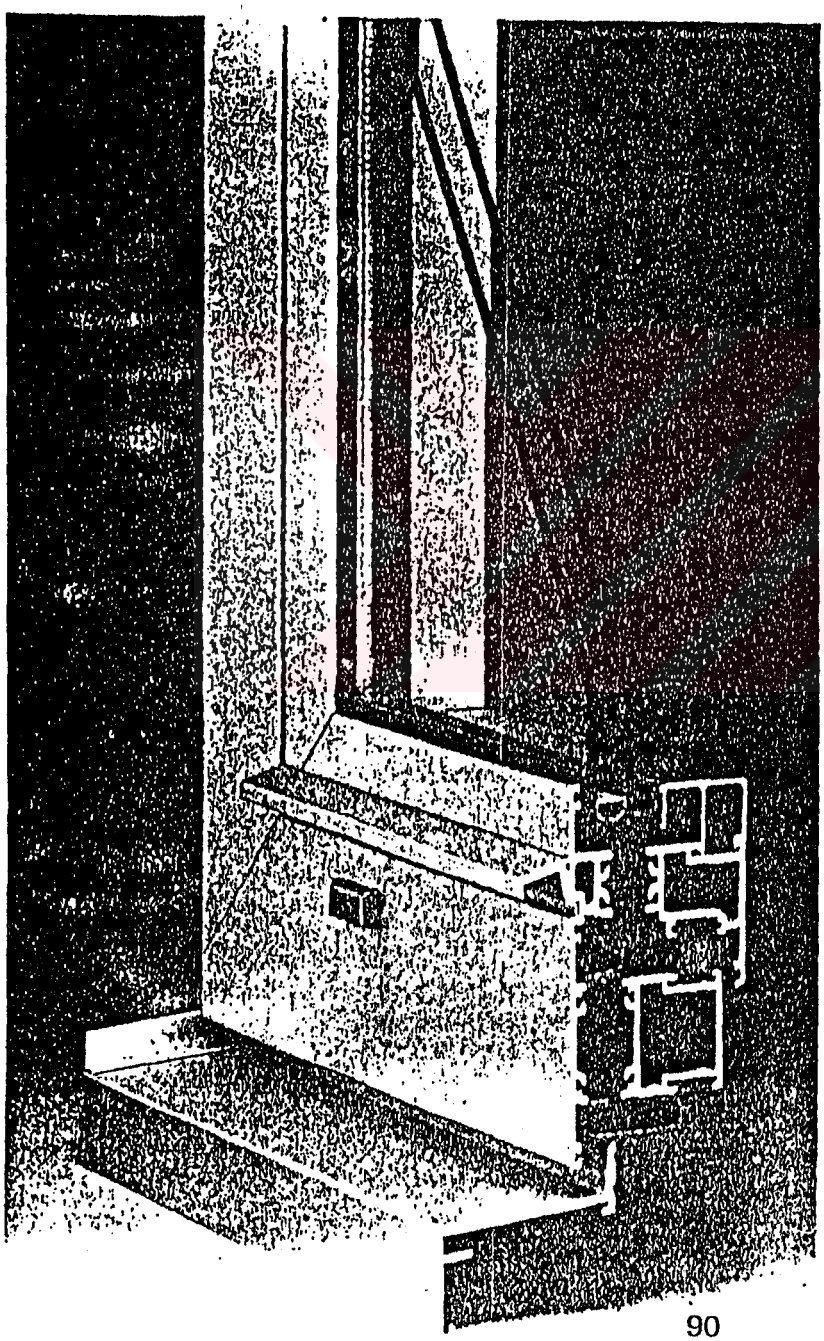


LOKMAN DEMİRDÖĞEN BUSINESS CENTER
SYSTEM: TF1400 CURTAIN WALLS

SYSTHERM® 62

WÄRMEDÄMMKONSTRUKTIONEN

mit Systemgarantie



90

DÄMMSTEGE:
Polyamid glasfaserverstärkt
wärmebeständig bis 200°C

WÄRMESCHUTZ:
DIN 4108
Rahmenmaterialgruppe **2.1**

$k_F = 2{,}3$ W/m²K
mit Isolierglas 2 · 12 mm SZR

$k_F = 2{,}9$ W/m²K
mit Isolierglas 1 · 12 mm SZR

SCHALLSCHUTZ:
DIN 4109
Schalldämmaß bis R_w 47 dB
Schallschutzkl. 2, 3, 4, 5 nach Glas

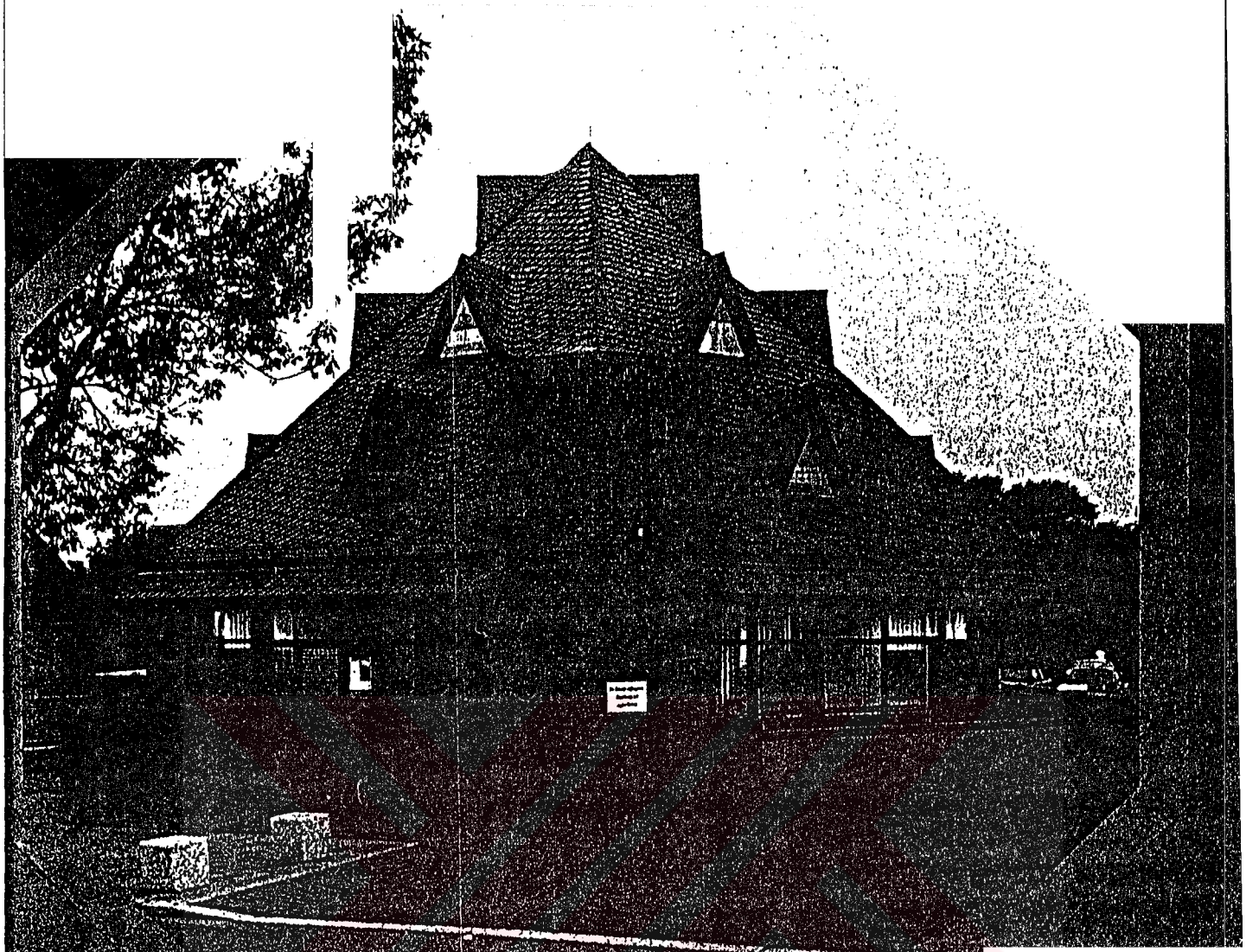
FUGENDURCHLÄSSIGKEIT
SCHLAGREGENDICHTHEIT:
DIN 18 055
a < 0,1 m³/hm, Gruppe C

BAUTIEFE:

Rahmenprofile	**62** mm
Flügelprofile-Fenster	**72** mm
Flügelprofile-Türen	**62** mm

ÖFFNUNGSARTEN:
Drehkippfenster
Drehfenster
Kippfenster
Dreh-, Drehkippfenster
Drehkipptür
Anschlagtür
Hebeschiebefenster
Hebeschiebetür

RAL Gütegeprüfte Beschläge
Alle Teile nicht rostend



HARTMANN

Fenster, Türen und Wintergärten

W. HARTMANN & CO. (GmbH & CO.)

HARTMANN DOĞRAMA SİSTEMİ ÖZELLİKLERİ

Hartmann serilerinin tüm elemanları TSE ve DIN standartlarındadır ve inşaat fiziğine uygun özellikler taşırlar. Profillerin tümü ısı yalıtımlıdır. Taşıyıcı iç profiller ile dış profillerden oluşan ısı yalıtımlı profillerde ısı yalıtımları cam elyaf takviyeli polyamit'ten imal edilirler.

Bu malzeme sayesinde tüm konstrüksiyonlarda ısı köprüleri (ısı kaçışı) meydana gelme ihtimali ortadan kalkmakta ve yakıt tüketimine etki edebilecek olumsuz etkiler giderilmiş olmaktadır. Elde edilen "k" değeri DIN 4108 bölüm 4 tablo 3 normuna uygun olarak 12 mm çift boşluklu ısı yalıtımlı cam için 1,978 kcal/m^2K dir. (2,3 W/m^2K) *

Isı yalıtımlı kasa ve kanat gibi birbiriyle çalışan profiller arasında kullanılan bini fitilleri ve cam ile profiller arasındaki cam fitilleri Elestomerli EPDM'den oluşmaktadır. Bu malzeme -30° den + 90°C sıcaklık dereceleri arasında büyük bir elastikiyet göstermekte ve geri dönüş gücüne sahip olmaktadır.

Bu fitillerin yalıtım gücü ve hava şartlarına dayanıklılığı sayesinde bakıma ihtiyaç göstermeksizin uygun bir kullanım ömrü garanti edilmektedir. EPDM yalıtım profilleri ile kullanılmakta olan "kuru sistem camlama " yöntemi, test koşulları altında ancak ölçülebilen a 0,1m^3/ hm geçirgenlik katsayısı göstermektedir. Bu değer DIN 18055 normuna göre "C" direnç sınıfına girmektedir.

Buhar basıncını dengelenmesi amacıyla usulüne uygun olarak yapılan kasa - Kanat havalandırması ve doğrudan dışarıya su akışını sağlayan delikler sayesinde camın oturduğu bölümün nemlenmesi önlenmektedir.

* Bu ısı yalıtım değeri Türkiye'de mevcut başka hiç bir alüminyum doğrama sisteminde yoktur. Çünkü ısı yalıtımın sağlandığı iki profil arasındaki hava boşluğu Hartmann sistemlerinde 20 mm dir.

- Estetiktir.
- Çevreyi kirletmez.
- Hızlı ve toplu inşaat sistemlerine uygundur.
- Ekonomiktir.
- Projenin gerçekleşme sürecinde zamandan, işçilikten tasarruf sağlar.
- Kullanım sürecinde işletme giderinden tasarruf sağlar.
- Standart kalitede üretim sağlar.

SİSTEM DOĞRAMA ÖZELLİKLERİ

Alüminyum Doğrama dış duvarın sayılan bir bölümüdür. Bu özelliği ile iç ve dış hacimler arasında ışık ve görsel bağlantıyı sağlarken, tam bir hava-su, sızdırmazlığı sağlamalıdır.

Bugün çağdaş yaşamda doğramanın ana fonksiyonlarına yeni yeni fonksiyonlar eklenmektedir.
Doğrama artık duvarın değil, cephenin bir elemanıdır.
Sistem doğrama profilleri yalnızca birbiriyle çalışan profiller olmayıp, en ufak vidasına kadar tüm aksesuarları ile ele alınıp tasarlanmış, İmalat ve montajda malzeme, emek ve zamanı en optimal boyutlarda kullanan elemanlar bütünlüğüdür.
Sistem doğramalar yapı cephelerinin problemlerinde üstüne düşen tüm görevleri çözmek üzere tasarlanmıştır.

ISI YALITIMLI DOĞRAMA GEREKLİLİĞİ

Türkiye gibi enerji ihtiyacının yarısını döviz ödeyerek karşılayan bir ülkede enerji tasarrufu öncelik taşır. Enerji tasarrufu;daha ilkel metodlardan İleri metotlara, ileri teknolojilere geçmek demektir.

Gelişmiş ülkelerde binaların ısıtılmasına harcanan enerjinin denetimine büyük bir ağırlık verilmektedir.

Isı yalıtımlı profiller aynı zamanda ses yalıtımı üzerinde de olumlu etki yapmakta ve kullanılan cam cinsine bağlı olarak DIN 52210 normuna göre 5. sınıfa kadar ses yalıtımı sağlayabilmektedir.
(RW= 40 - 44 dB)
Hartmann sistem serisi çercevesinde üretilen Alüminyum profiller ile oluşturulmuş her tür doğrama gerek yeni binalarda gerekse eski yapı restorasyon projelerinde en uygun ve ekonomik çözüm olarak görülmekte ve proje sahibi mimarın ve inşaat sahibinin yaratıcı taleplerine uygun düşmektedir.

Hartmann sistemleri profilleri ile her türlü; giydirme cephe, eksenel döner-yatar, döner, çift eksenli hafif sürme, ağır kaldırma-sürme, çekme paralel sürme, iner-kalkar, içe-dışa açılır pencere ve kapı sistemleri üretmek, sahip olunan geniş imalat paleti sayesinde değişik kombinasyonlarla mümkün olabilmektedir.

Hartmann doğrama sistemleri ; her tür mimari, statik, yapı fiziği problemlerine cevap verecek zenginlikte dizayn edilmiştir. Profilleri en üfak tırnağından, ara boşluklarına, fitil yuvalarına, profil kesitlerine kadar bağlantı-çalıştırma aksesuarları, su tahliyesi, nem dengelenmesi vb. yapı kabuğu problemleri düşünülerek dizayn edilmiştir.

Profiller, yapı estetiğine katkıda bulunacak şekil, kombinesyon ve kalitededirler. Yurt dışında yıllardır kabul görmüş,zaman içinde kendini yenileyip geliştiren Hartmann alüminyum doğrama sistemlerinin yılların birikimiyle oluşmuş teknoloji bilgisini yurdumuza kazandırmış olmakla önemli bir hizmet gördüğümüz kanaatindeyiz.

Yurdumuzda konut ve fabrika binalarında tüketilen ısı enerjinin tüm tüketimdeki payı % 15 dolaylarındadır. Bu miktarın yarısından fazlasının tasarruf edilebileceği düşünülürse bir yılda 7,6 milyon ton petrol eşdeğeri tasarruf sağlanacaktır.

Enerji tasarruf sağlayan ısı yalıtımlı alüminyum doğrama üretimine katkı amacıyla,batıda bu konuda önder firma olan Hartmann'ın bilgi birikimi ve teknolojisi yurdumuza kazandırılmıştır.

Hartmann Sistemlerinin özellikleri, TSE ve DIN normlarına uygunluğu, imalat şartları, Hartmann garanti belgeleri (Institut für Fenstertechnik e.v. rosenheim) ilişikte sunulmuştur.