



Student investigations in affordable housing design and production in the context of building and energy costs



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- 2. Prefabrication and solar systems integration as requisites for housing affordability**
- 3. A methodological approach based on key findings**
- 4. Application of findings to coursework development**
- 5. Concluding thoughts**



Introduction and Goals

- The goal of this research was to contribute to existing literature on **factors affecting housing affordability** by examining a **class-based demonstration project**.
- An investigation was carried out to **anticipate the initial stages of the design and construction processes**, specifically **focusing on prefabricated and modular housing typologies and the incorporation of building solar systems** (BIPVs & BISTs).
- A significant aspect of this work involved gathering a **diverse range of literature and precedent case studies**.
- Through this compilation, the **students identified appropriate construction methods and solar systems integration types** to support the prevalent model.

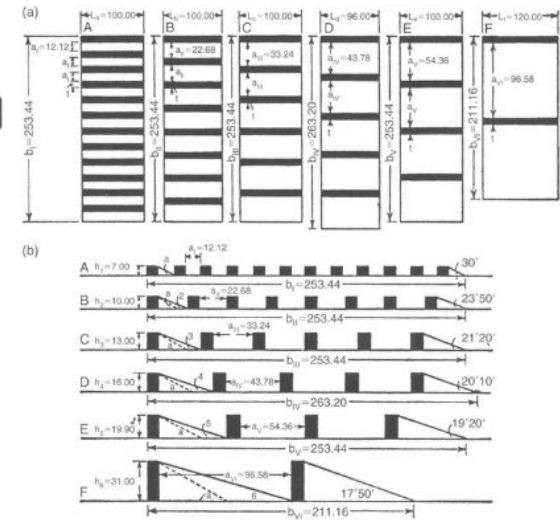
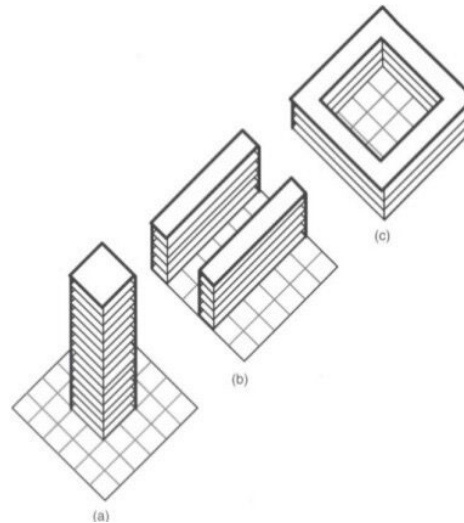


Introduction and Goals

- The team attempted to **leverage the acquired knowledge, both in a pilot project and the subsequent architectural design studio** coursework.
- The team **adapted suitable technologies and maximized local expertise to make informed decisions** regarding design, fabrication, transportation, assembly strategies and energy efficiency.
- This **multi-criteria approach was implemented** considering a comprehensive timeframe of works, **from the initial stages of component production through to on-site assembly**.
- Another unique aspect of this endeavor that **sought to weave academic instructional goals with findings derived from developing best practices** in the field.



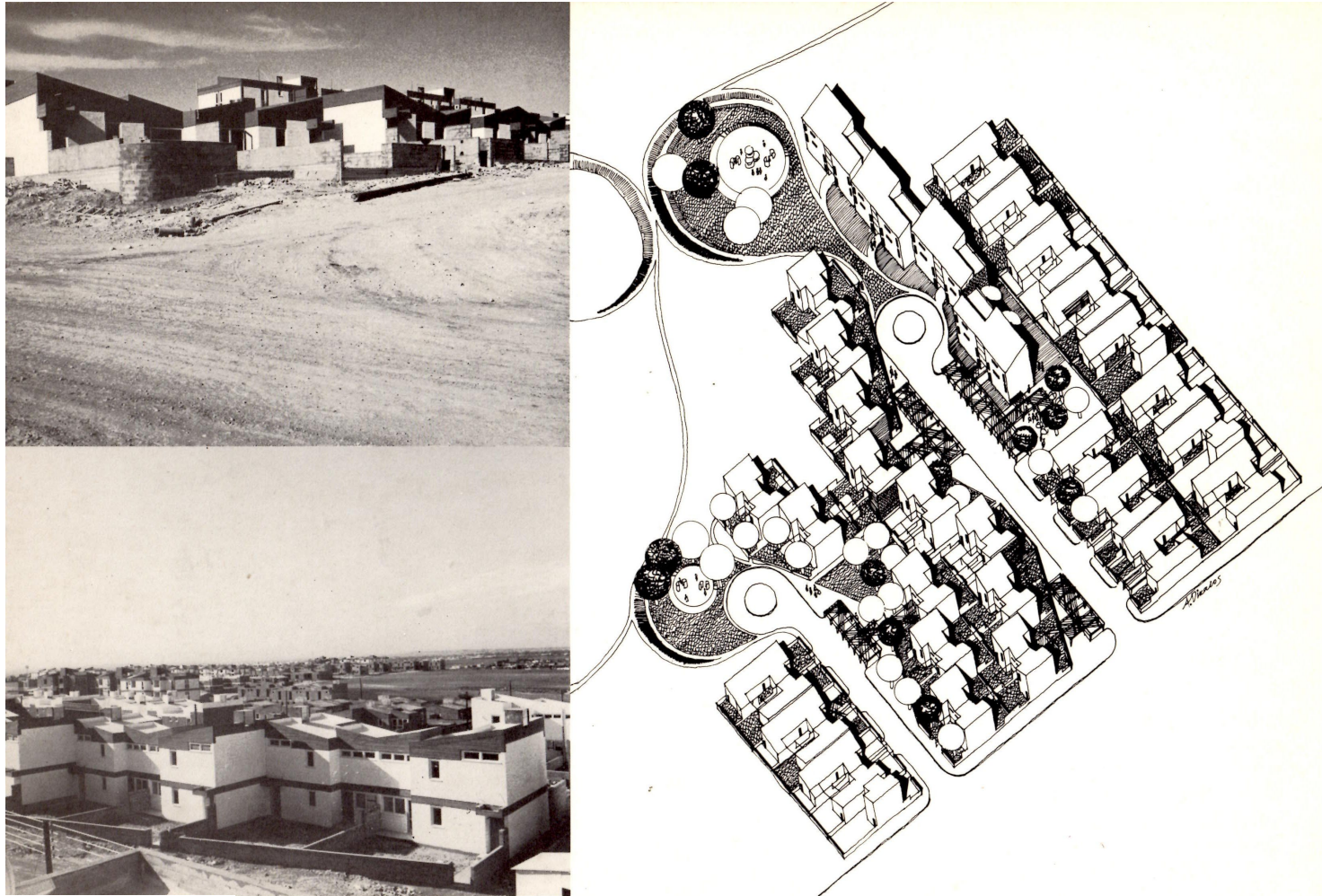
Prefabrication and solar systems integration as requisites for housing affordability



*A taxonomy of building typologies (center)
with studies from ‘La Ville Radieuse’ by Le Corbusier (left)
and the ‘Zielenbau’ housing block schemes by Walter Gropius (right).*



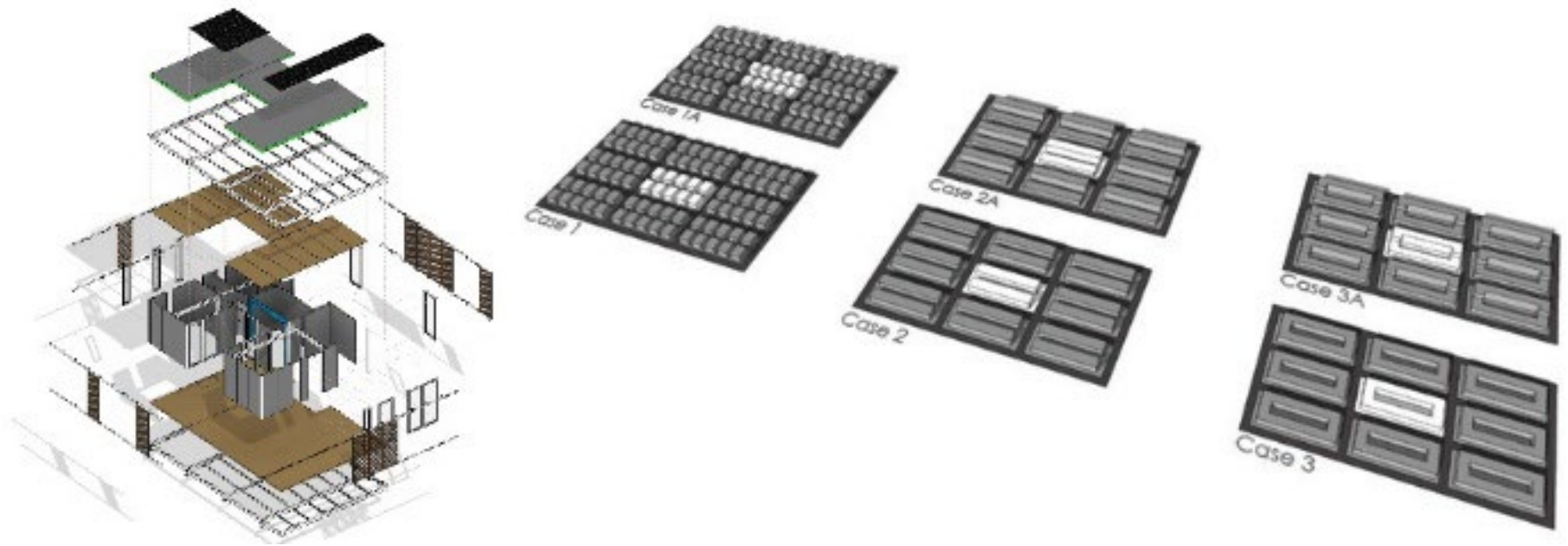
Prefabrication and solar systems integration as requisites for housing affordability



*Aerial photo of Strovolos Community Refugee Housing by CAEC (left)
Axonometric of 710 low-cost units of one-and-two-story houses and
three-story apartment blocks with services and open space design (right)*



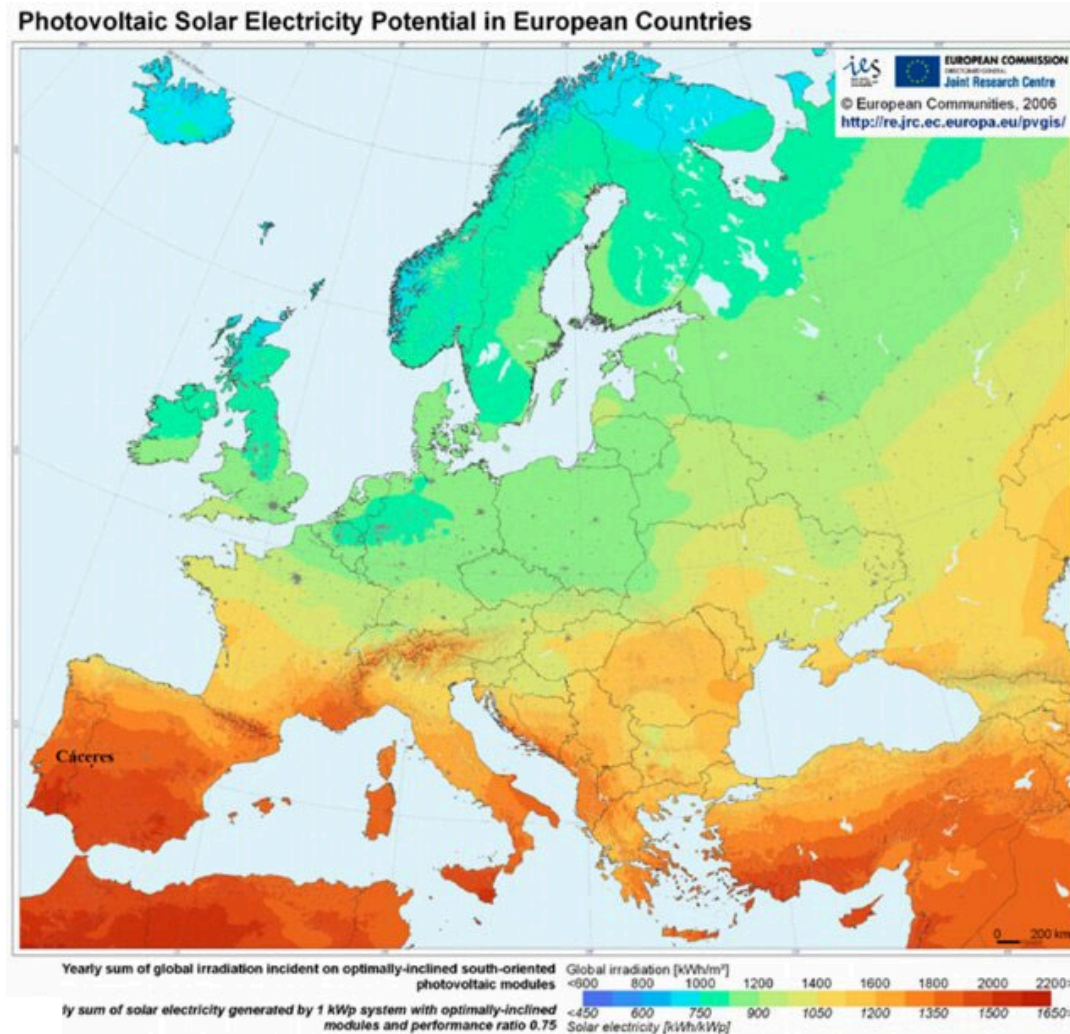
Prefabrication and solar systems integration as requisites for housing affordability



A proposal for a kit-of-parts as a key component for design and construction schemes based on prefabrication (left) and building massing studies keeping density constant (right)



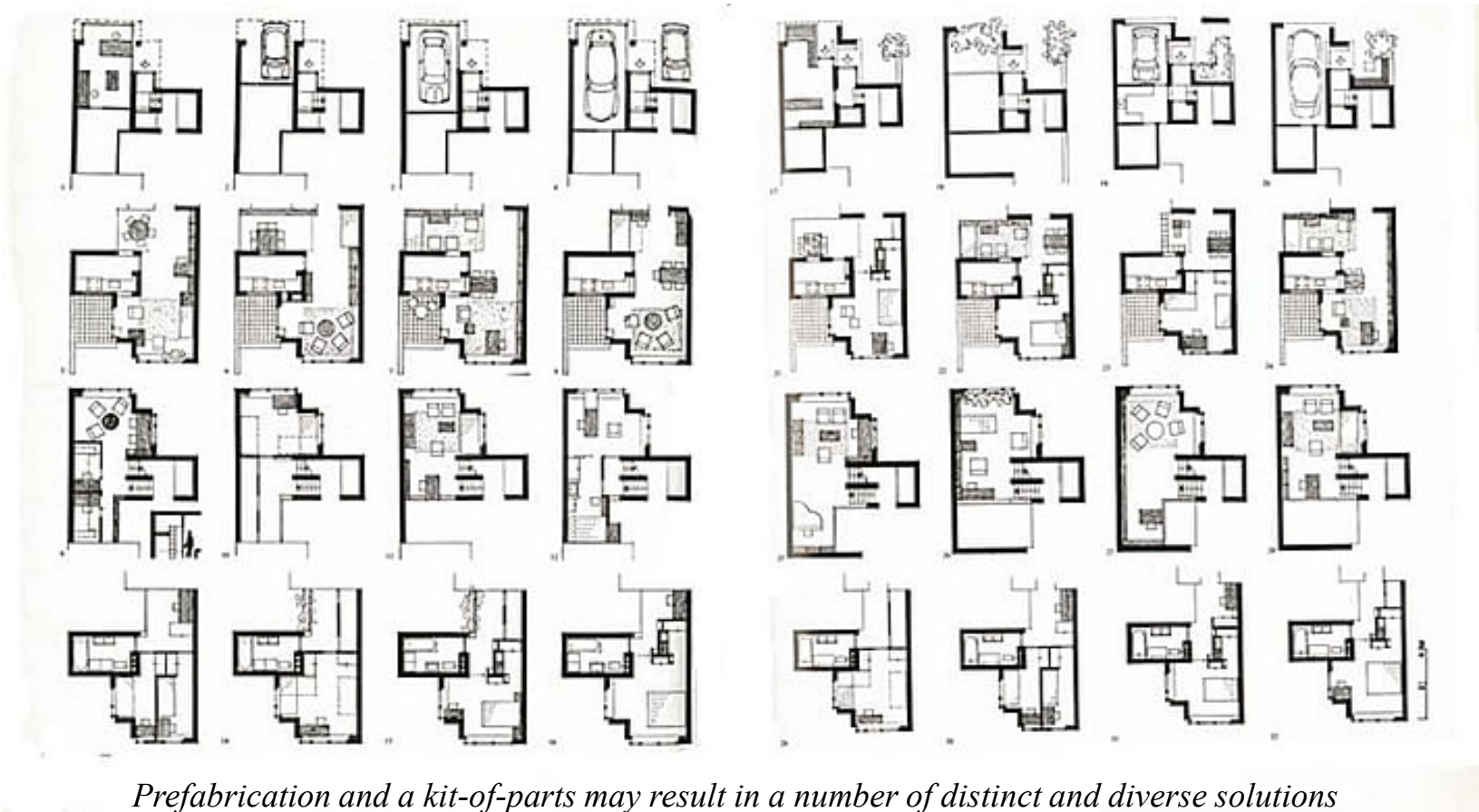
Prefabrication and solar systems integration as requisites for housing affordability



PV solar electricity potential in Europe



Prefabrication and solar systems integration as requisites for housing affordability

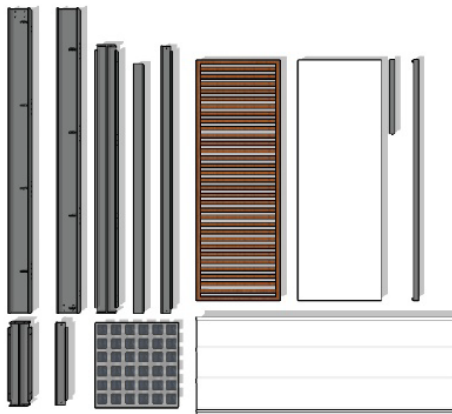


*Prefabrication and a kit-of-parts may result in a number of distinct and diverse solutions
As exemplified by the Hertzberger's Diagoon Housing Project in Delft, the Netherlands.*



A methodological approach based on key findings

TYPE OF CONSTRUCTION	PreFab Unit	Light-Weight	Timber-Frame	CMU	Conventional
COST (€)	8 773, 51	13 125, 20	10 170,64	13 292, 56	13 223, 53



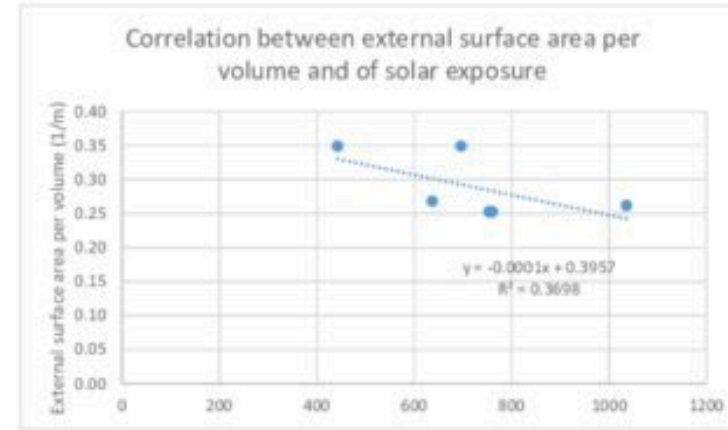
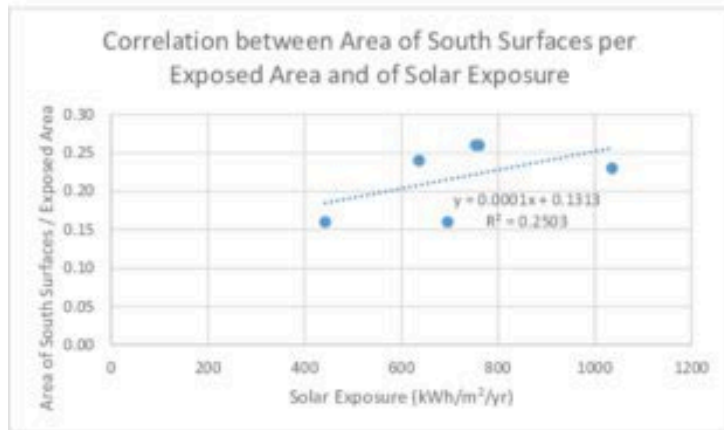
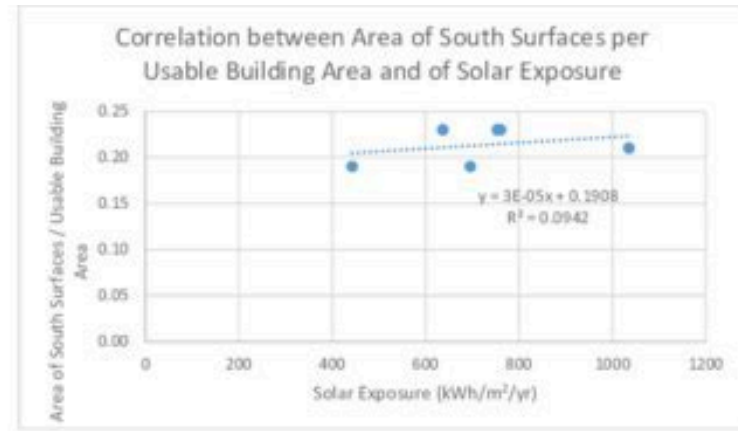
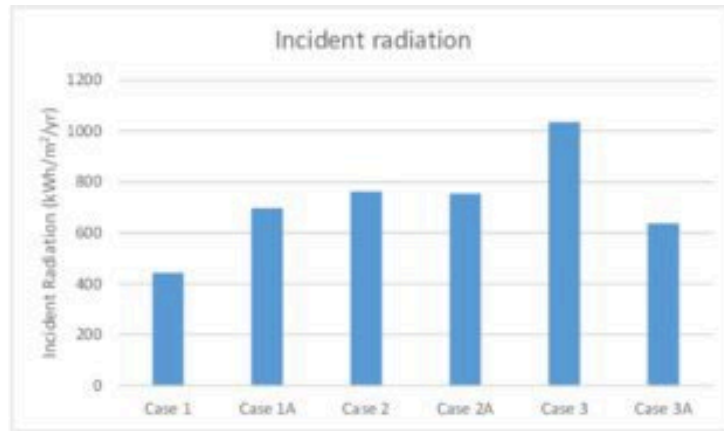
TYPE OF CONSTRUCTION	PreFab Unit	Conventional	Light-Weight	Timber-frame	CMU
COSTS (€)					
Foundation	-	1 695.00	2 839.80	2 839.80	2 839.80
Structure	4 610.81	4 916.81	4 610.81	653.00	2 531.60
Roof	1 921.50	1 475.80	1 472.46	2 284.18	1 421.80
Floor	1 428.00	801.74	801.74	801.74	801.74
Masonry	813.20	1 845.30	3 591.20	3 591.20	1 532.30
Coating & Paints	-	2 698.08			2 994.28
TOTAL (€)	8 773.51	13 223.53	13 125.20	10 170.64	13 292.56
TOTAL (€/m²)	292.45	440.78	437.51	339.02	443.09

Estimated Cost per 30 sq.m. unit (top)

Construction cost analysis; prefab unit Vs conventional construction Vs light-weight construction Vs timber-frame construction Vs CMU construction (bottom)



A methodological approach based on key findings



Incident solar radiation charts (kwh/m²/yr) for each massing scheme



A methodological approach based on key findings

Prefab Eco Smart House

Το προκατασκευασμένο Eco Smart House υλοποιήθηκε
στο πλαίσιο ενός συγχρηματοδοτούμενου
προγράμματος της Ευρωπαϊκής Ένωσης.

Ευχαριστούμε όλους τους φορείς που επέλεξαν την
ΗΛΥΜΕΤ ως κατασκευάστρια εταιρία αυτού του
καινοτόμου και πρότυπου έργου.

PreFab Eco-Smart housing unit realized with Elymet



Application of findings to coursework development

Based on the above, the semester long process led the students through the following steps:

Architectural design

Building on the key design strategies and parameters, the investigation progressed to examine potential architectural morphologies.

The focus was on achieving a construction cycle that is cost-effective, promotes straightforward assembly, and enhances energy efficiency while minimizing operational costs **through a comparative analysis of:**

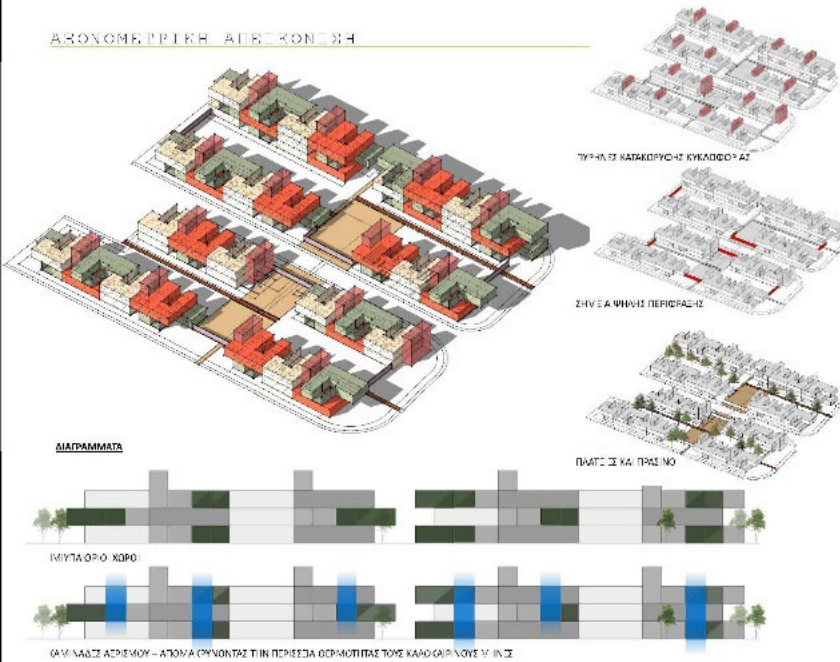
- **Material choices and methods of construction**
- **Cost analysis and financial pro forma**
- **Daylighting simulations**
- **Passive design strategies**



Application of findings to coursework development

ΚΕΝΤΡΟ ΥΠΟΔΟΧΗΣ ΜΕΤΑΝΑΣΤΩΝ

ΑΡΧΙΤΕΚΤΟΝΙΚΗ ΑΠΕΙΚΟΝΙΣΗ



ΚΕΝΤΡΟ ΥΠΟΔΟΧΗΣ ΜΕΤΑΝΑΣΤΩΝ

MASTER PLAN

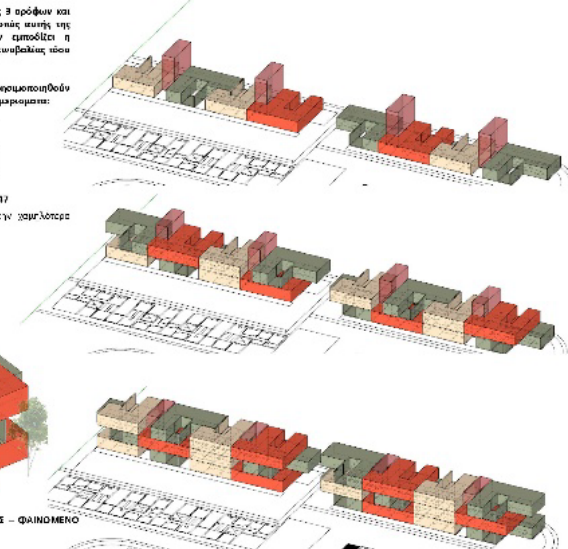
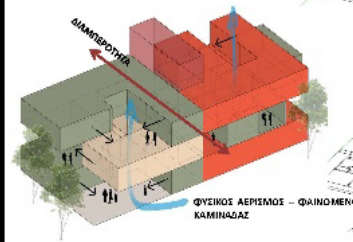
Βόρεια του τεμαχίου 1 χωροθετούνται 2 πτέρυγες 3 ορόφων και στην νότια πλευρά του 2 πτέρυγες 2 ορόφων. Σκοπός αυτής της διαφοροποίησης στους ορόφους είναι να μην εμποδίζει η μαρτυρική ταμπάκ το κτίσιμο της ηθικής απανταχού και στην κλίση πτέρυγα δύο και στον πλατεϊακό χώρο.

Με βάση αυτή την χωροθέτηση και με στόχο να χρησιμοποιηθούν όλες ακριβώς είναι δυνατό λαμβάνοντας 64 διαμερίσματα:

- 25 ΔΙΑΜΕΡΙΣΜΑΤΑ 3 ΥΠΟΔΟΜΗΤΙΚΑ (75 άτομα)
- 29 ΔΙΑΜΕΡΙΣΜΑΤΑ 4 ΥΠΟΔΟΜΗΤΙΚΑ (92 άτομα)
- 10 ΔΙΑΜΕΡΙΣΜΑΤΑ 5 ΥΠΟΔΟΜΗΤΙΚΑ (50 άτομα)

Συνολικό στάθμο που μπορούν να φιλοξενηθούν: 217

Η τυποποίηση των διαμερισμάτων συμβάλει στην χαμηλότερη κίνηση και απώλεια, για οικολογικά όφελος.



*Indicative student project proposal
by Anna Chartoupallou,
based on the stated design objectives*



Application of findings to coursework development

ΚΕΝΤΡΟ ΥΠΟΔΟΧΗΣ ΜΕΤΑΦΑΣΤΩΝ

ΤΕΧΝΟΟ-ΚΟΙΝΩΜΙΚΗ ΜΕΛΕΤΗ

A. ΥΠΟΛΟΓΙΣΜΟΣ ΣΥΝΤ.ΚΑΛΥΨΗΣ

4545m ²	4545/11309=39%
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ΥΠΟΛΟΓΙΣΜΟΣ ΣΥΝΤ.ΔΟΜΗΣΗΣ

6956m ²	6956/11509=57%
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B. ΥΠΟΛΟΓΙΣΜΟΣ ΜΕΛΛΟΝΤΙΚΩΝ ΧΡΗΣΤΩΝ

ΤΥΠΟΣ ΔΙΑΜΕΡΙΣΜΑΤΟΣ	ΑΡΙΘΜΟΣ	γ ²	γ ³
ΔΙΑΜΕΡΙΣΜΑ 2 ΥΠΝΟΔΩΜΑΤΩΝ	25	92	1300
ΔΙΑΜΕΡΙΣΜΑ 3 ΥΠΝΟΔΩΜΑΤΩΝ	23	114	1623
ΔΙΑΜΕΡΙΣΜΑ 4 ΥΠΝΟΔΩΜΑΤΩΝ	16	129	2064

C. ΔΕΔΟΜΕΝΑ

ΔΕΔΟΜΕΝΑ		μ ²	4=4 ΜΕΡΑΔΗ ΠΡΩΗ ΚΤΙΡΙΑΤΟΔΟΓΩΝΕΙ
Α	ΤΕΛΕΛΟΙΟ 1	5,040.00 €	504,700.00
	ΤΕΛΕΛΟΙΟ 2	6,059.00 €	471,100.00
	ΕΜΒΑΔΟΝ ΠΡΟΤΑΣΗΣ	11,909.00 €	975,800.00
Β	ΚΟΣΤΟΣ ΟΙΚΟΠΕΔΟΥ	81.34	€/m ²
Γ	ΚΟΣΤΟΣ ΚΑΤΑΣΚΕΥΗΣ	750.00	€/m ²
Δ	ΚΟΣΤΟΣ ΦΩΤΟΒΟΛΤΑΙΚΩΝ	700.00/0.01	€
Ε	ΤΙΜΗ ΠΩΛΗΣΗΣ	1,100.00	€/m ²
Ζ	ΕΜΒΑΔΟΝ ΠΡΟΤΑΣΗΣ	6,986.00	m ²

Το κόστος ενός ημεδαπών αυτών: κόστος είναι περίπου 750€/m².

D. ΥΠΟΛΟΓΙΣΜΟΣ ΕΣΠΡΑΞΕΩΝ-ΚΑΘΑΡΟΥ ΚΕΡΔΟΥΣ

ΣΥΝΟΛΙΚΟ ΚΟΣΤΟΣ ΟΙΚΟΠΕΔΟΥ	€	975,800.00	
ΣΥΝΟΛΙΚΟ ΚΟΣΤΟΣ ΚΑΤΑΣΚΕΥΗΣ	€	5,939,500.00	ΚΟΣΤΟΣ ΚΑΤΑΣΚΕΥΗΣ/ ΕΜΒΑΔΟΝ ΠΡΟΤΑΣΗΣ +ΚΟΣΤΟΣ ΦΩΤΟΒΟΛΤΑΙΚΩΝ
ΕΣΠΡΑΞΕΙΣ	€	7,684,600.00	ΤΙΜΗ ΠΩΛΗΣΗΣ*ΕΜΒΑΔΟΝ ΠΡΟΤΑΣΗΣ

ΚΕΝΤΡΟ ΥΠΟΔΟΧΗΣ ΜΕΤΑΦΑΣΤΩΝ

ΤΕΧΝΟΟ-ΟΙΚΟΝΟΜΙΚΗ ΜΕΛΕΤΗ

D. ΥΠΟΛΟΓΙΣΜΟΣ ΕΣΠΡΑΞΕΩΝ-ΚΑΘΑΡΟΥ ΚΕΡΔΟΥΣ

SECURITY	ΤΙΜΗ ΟΙΚΟΠΕΔΟΥ*2.1%	€	20,491.80
COMMISSION	ΤΙΜΗ ΟΙΚΟΠΕΔΟΥ*3%	€	29,274.00
TRANSFER(ΜΕΤΑΒΙΒΑΣΗ)	85000*3.6%	€	3,060.00
	85000*5%	€	4,250.00
	(975800-170000)*8%	€	64,164.00
ΣΥΝΟΛΙΚΟ TRANSFER		€	71,774.00
TOTAL COST	ΣΥΝΟΛΙΚΟ ΚΟΣΤΟΣ ΚΑΤΑΣΚΕΥΗΣ+ΣΥΝΟΛΙΚΟ ΚΟΣΤΟΣ ΟΙΚΟΠΕΔΟΥ+SECURITY+COMMISSION+TRANSFER	€	6,061,039.80
ΚΕΡΔΟΣ	ΕΣΠΡΑΞΕΙΣ-TOTAL COST	€	1,623,560.20
ΦΟΡΟΛΟΓΙΑ	ΚΕΡΔΟΣ*5%	€	81,178.01
ΚΑΘΑΡΟ ΚΕΡΔΟΣ	ΚΕΡΔΟΣ-ΦΟΡΟΛΟΓΙΑ	€	1,542,382.19
			70.07%

E. ΔΕΙΚΤΗΣ ΡΗΤ

Rate	0.0202	=	2.00166027
Rate	0.0252	=	2.50
Rv	0.2000	=	4.0000
Rate		=	number
Rate		=	number
		=	188.92/12m ²

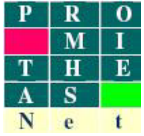
ΤΙΜΗ ΠΩΛΗΣΗΣ ΕΝΟΣ ΔΙΑΜΕΡΙΣΜΑΤΟΣ 2 ΥΠΝΟΔΩΜΑΤΙΩΝ	€	101,200.00
10% ΔΙΝΟ ΜΠΡΟΣΤΑ	€	10,120.00
ΑΠΟΠΛΗΡΩΜΗ 30ΧΡΟΝΙΑ ΜΕ ΕΠΙΤΟΚΙΟ 5%	€	91,080.00
ΜΗΝΙΑΙΑ ΔΟΣΗ		488.94
ΚΑΘΑΡΟ ΕΙΣΟΔΗΜΑ ΝΟΙΚΟΚΥΡΙΟΥ		1746,214286

*Indicative student project proposal
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based on the stated design objectives*



Concluding thoughts

- A studio-based **class assignments should strive to promote a holistic perspective**, considering not only the technical aspects but also project feasibility, financing and **long-term building life cycle performance**.
- This could serve as a **stepping-stone towards creating more sustainable communities**, utilizing potential opportunities such as **new** residential neighborhoods, **infill** developments, **renovations** of existing estates **or the use of vacant and underutilized lots** within existing residential areas.
- By addressing these issues, this investigation hopes **to encourage a shift towards more sustainable and adaptable affordable housing models**.



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Thank you for your attention