

**CERTIFICATION FOLDER  
OF P/V MOUNTING SYSTEM  
STATIC ANALYSIS**

Company: **GÜRSAN  
ALUMINYUM IMALAT SAN L.T.D.\***

Product: **‘ESTIA’ Mounting System**

Cert.No: **TÜVR.SP23/2013**

Inspection  
Report No: **TÜVR – ALUMINCO AE IR01/2012**

Date of Issue: **17/10/2012**

The Inspector



**Kleanthis Papanikolaou  
Dipl. Civil Engineer**

\* Aluminco S.A. company cooperates with Gursan L.T.D. in Turkey

**TÜV RHEINLAND HELLAS**

**INSPECTION REPORT**  
**ΕΚΘΕΣΗ ΕΠΙΘΕΩΡΗΣΗΣ**

<b>Project</b> <b>Έργο</b>	: <b>Certification of P/V mounting system Static Analysis and Study</b> <b>Πιστοποίηση Στατικής Μελέτης Βάσεων Φωτοβολταϊκών</b>
<b>TUV-R-PROJECT No</b> <b>Κωδικός Έργου</b>	: -
<b>Our Ref.No.</b>	: <b>TUVR – ALUMINCO AE IR01/2012</b>
<b>Owner</b> <b>Κύριος του Έργου</b>	: <b>GÜRSAN LTD*</b>
<b>Contractor</b> <b>Ανάδοχος</b>	: -
<b>Fabricator</b> <b>Κατασκευαστής</b>	: <b>GÜRSAN LTD*</b>
<b>Subject of inspection</b> <b>Αντικείμενο Επιθεώρησης</b>	: Adequacy and completeness check of the structural design and static analysis and study with code name <b>MTML_12-S-02</b> , referring to the P/V mounting system 'ESTIA' (aluminum tile type) of the company GÜRSAN LTD*.
<b>Inspection activities</b> <b>Έλεγχοι κατά την Επιθεώρηση</b>	: Adequacy check of the static analysis issue of the aluminum tile type P/V mounting system and compliance check of the overall study with current regulations in force. Elaborate reference of: 1. Documentation 2. Basic Assumptions – Specifications 3. Results – Conclusions can be found in <i>Attachment 1: Assessment of competence of static analysis folder</i>
<b>Place of inspection</b> <b>Τόπος Επιθεώρησης</b>	: Headquarters of <b>TÜV Rheinland Hellas</b> in Elefsina, Greece.
<b>Date(s) of inspection</b> <b>Ημερ. Επιθεώρησης</b>	: <b>17/10/2012</b>
<b>Requirements / Specifications</b> <b>Απαιτήσεις / Προδιαγραφές</b>	: Standards EN 1990, EN 1991-1-1, EN 1991-1-3, EN 1991-1-4 and the National Anti-seismic Design Regulation (EAK 2000 – amendment of 2003)
<b>Attachments</b> <b>Επισυναπτόμενα</b>	: Attachment 1, Assessment of static analysis with code name <b>MTML_12-S-02</b> Attachment 2, Detailed strength results of critical points on tiles (7 pages, studied by: Dipl. Mechanical Engineer Mr. Emmanuel Stathatos).
<b>Remarks</b> <b>Παρατηρήσεις</b>	: According to the strength results of the static analysis (see Attachments 1 and 2) the overall structural study meets the recommendations and provisions of the current regulations in force and also fulfills all structural and assembly requirements for the particular mounting system.

<b>Date</b> <b>Ημερομηνία</b>	:	<b>17/10/2012</b>
<b>Inspector</b> <b>Επιθεωρητής</b>	:	<b>Kleanthis Papanikolaou</b>

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<b>Our Ref.No.</b>	<b>TÜVR – ALUMINCO AE IR01/2012</b>
<b>Attachment 1</b>	

### **ASSESSMENT OF COMPLETENESS OF STATIC ANALYSIS FOLDER**

This inspection report includes an assessment of the structural design and static analysis adequacy of the P/V mounting system of the company GÜRSAN L.T.D. \*.

#### **1. DOCUMENTATION**

The submitted documents for audit and assessment are the following:

- A) Static analysis report of Aluminco P/V mounting system**
- B) Spatial layout plans, parts assembly excluded**  
**Plan of mounting system of ESTIA P/V unit**  
  
**Fig.1 3D representation of the overall system with file name 3LX2 fast-lock II**  
**Fig.2 Zoom of the drawing - Picture 2.4, page 6 of static analysis issue**
- C) Structural designs of aluminum profiles – mounting elements**  
  
**Beam section: Picture 2.1, page 4 of static analysis issue**  
**Light beam section: Picture 2.2, page 5 of static analysis issue**

#### **2. BASIC ASSUMPTIONS – SPECIFICATIONS**

Documentation elements A, B and C were subjected to compliance check with the following international standards: EN 1990, EN 1991-1-1, EN 1991-1-3, EN 1991-1-4 and the National Anti-seismic Design Regulation (EAK 2000 – amendment of 2003).

Detailed examination of the study and plans submitted showed the following:

- The static analysis and study with code name **MTML\_12-S-02**, conducted by Dipl. Mechanical Engineer Emmanouel Stathatos using Finite Element Analysis, fully complies with the directions of the Eurocode and the EAK.
- The material of the frame is Aluminum alloy **AlMgSi 6063656**. Specifications:
  - Elasticity: E= 69 GPa
  - Poisson ratio:  $\nu = 0.3$
  - Specific gravity:  $\epsilon = 2.7 \text{ t/m}^3$
  - Yield strength:  $f_u = 255 \text{ MPa}$
  - Failure stress:  $f_o = 225 \text{ MPa}$
- Material of tiles is Aluminum alloy **AlSi12**. Specifications:
  - Elasticity: E= 69 GPa
  - Poisson ratio:  $\nu = 0.3$
  - Specific gravity:  $\epsilon = 2.7 \text{ t/m}^3$
  - Yield strength:  $f_u = 150\text{-}230 \text{ MPa}$
  - Failure stress:  $f_o = 110 \text{ MPa}$
- Material of accessories is Aluminum alloy **AlMgSi 606040**. Specifications:
  - Elasticity: E= 69 GPa
  - Poisson ratio:  $\nu = 0.3$
  - Specific gravity:  $\epsilon = 2.7 \text{ t/m}^3$
  - Yield strength:  $f_u = 220 \text{ MPa}$
  - Failure stress:  $f_o = 190 \text{ MPa}$

- For the modeling of tiles 3D CAD drawings are imported into the ANSYS Workbench software in the form of parasolid binary and they are displayed with appropriate 3D finite elements (tetrahedral of 10 knots and hexahedral of 20 knots where possible).
- The method used for the Linear Elastic Static analysis is Finite Elements. Four types of metal tiles (namely: Roman, Dutch, French, Swedish) were modeled with FEA and subjected to stresses, corresponding to the reaction forces of the P / V panel (4Rx5) support system. The static adequacy of the tiles was tested with the method of equivalent stresses according to Von Mises, with positive results.
- Typical load values:
  - **Wind load value:  $q = 1.4770 \text{ kPa}$** , that is for wind speed of **33 m/sec**
  - **Snow load value:  $s = 1.01 \text{ kPa}$**  for ground zone A,B altitude 700m
  - **Dead load** of the P/V panels  **$0.15 \text{ kN/m}^2$** .
  - **Earthquake induced dynamic load**, seismicity zone **III**, ground acceleration  **$a = 0.36g$** , Seismic behavior rate of  **$q = 1.5$** , structure importance factor  $\gamma = 1$ .
  - **P/V panel weight: 22 kg/panel**

### 3. RESULTS - CONCLUSIONS

- **In conclusion, the static analysis and overall structural study meets the recommendations and provisions of the current regulations in force.**
- The results of all strengths – stresses for every possible inclination angle and loading condition are presented in detail in the static analysis issue with code name **MTML\_12-S-02**.

\* Important Note: Testing and certification does not include the verification of the numerical results of the submitted study. The sole responsibility of the correctness and authenticity of the numerical calculations and results of the study lies with the engineer - designer.

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**Elefsina 17/10/2012**

**The inspector: Kleanthis Papanikolaou**



<b>Our Ref.No.</b>	<b>TÜVR – ALUMINCO AE IR01/2012</b>
<b>Attachment 2</b>	

**STRENGTH RESULTS OF CRITICAL MEMBERS**

**1. DETAILED RESULTS**

This document is accompanied with:

1. The one-page document that shows the last page of the structural design which describes the positive results regarding the adequacy of the static structure of the base signed and sealed by the engineer – designer.
2. The seven -page document containing the detailed results of static analysis in order to better describe the marginal prices of section 1.1 based on finite elements charts, signed and sealed by mechanical engineer Mr. Emmanuel Stathatos.

**Elefsina 17/10/2012**

**The Inspector: Kleanthis Papanikolaou**

